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For men engaged in the operating branch of the refining and natural gasoline business.

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R. L. DUDLEY..Manager and Editor

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Can There Be Too Many Cracking Plants?

"WHAT will be the result if the great majority of the refineries of the United States install cracking plants? Won't this mean an over-production of gasoline with resultant low prices?"

These questions, asked by refinery men answering our recent questionnaire on the Refiner, are no doubt questions that many other refinery executives have been pondering on.

Undoubtedly, if a plentiful supply of crude oil is maintained, the universal use of cracking processes will mean more gasoline with lower prices for it. But that does not necessarily mean a loss to the refinery operating a cracking process.

Cracking processes will permit the manufacture of more gasoline for a given sum of money. Consequently, should competition among cracking processes result in a flood of gasoline, the efficiently operated refinery will be able to reduce his price on gasoline and still clear a profit.

But there is no assurance that the supply of crude oil will be unlimited. We hear a lot of talk about the Lord providing, and to the effect that the Powers Above would never have allowed the need for lubricants to become so great if they had not provided plenty of oil—

But we noticed back about three years ago when the independent refiner was paying $3.50 for his crude plus fifty to seventy-five cents per barrel premium on it ,these "Lord will providers" took to their holes.

We are seeing a flood of crude oil right now that it is folly to expect to continue for ever. The world will undoubtedly continue to produce a tremendous amount of crude oil for years and years to come, but at the present rate of depletion in the United States, that product may be precious here before many years.

Then will the true blessing of the cracking process, the true blessing to the motorist and the refiner as well, be made known.

Answering definitely the question above, our opinion is:

"Yes, more cracking processes probably will lower the cost of gasoline if the prescnt supply of crude continues, but economically and financially the cracking process will be vindicated more and more as the years go by."

Any system of manufacture that gets out of a raw material more of a necessary product than any ordinary system, has a place in the business world.

We'd like to know what other of our readers think.

The Picture used on the front cover of the June issue of The REFINER AND NATURAL GASOLINE MANUFACTURER shows the plant of the Marland Refining Company at Ponca City, Oklahoma. It is reproduced through the courtesy of the "Marland Oils"

The Use of Aluminum Chloride in Cracking

Substance effects dissociation of higher boiling hydrocarbons and re-association of low gaseous hydrocarbons, catalytically

*By Louis Reiss and I. Epstein**

In a previous article (January, 1923, issue, page 5), the principles involved in the various cracking processes were reviewed briefly. In addition to the commercially successful processes, most of which are of the "pressure and heat" type, the writers of that article also mentioned several methods of cracking whose principles differed radically from the more popular methods. New patents in the "heat and pressure" class are constantly running the risk of being involved in lengthy litigation. This situation is already so serious that it has been suggested that all such patents be nullified, and that everybody concerned be asked to start over again with developments to date as common property. The present writers are pleased to note that this supposedly discouraging condition is not without its compensation, as the technologists in the oil industry are emerging from the old practices of "rule of thumb" methods and requiring more and more the intelligent direction of the trained oil chemist and engineer. And the latter have fallen back to well established but heretofore purely scientific facts for new ideas which are ripe for development into cracking processes.

The use of aluminum chloride is one of the earliest and one of the most effective departures from the numerous physical methods in use. We have found it expedient to reclassify all processes into physical, electrical and chemical. The agencies of temperature and pressure may be considered agencies for causing the dissociation of high boiling point hydrocarbons into lower boiling point hydrocarbons. In the electrical processes, one of which was outlined by E. W. Stevens in a previous issue, electrical energy is converted into chemical energy directly, involving ultimately a chemical change in the composition of the petroleum hydrocarbons. In the chemical processes, chemicals are utilized to effect this change. In our opinion, it is in this field that we may anticipate a great deal of success, as the surface has only been touched at the present time.

Upon the results of the researches of Friedel and Crafts, whose work at first had no particular bearing upon the petroleum industry, even though they did effect the synthesis of pure hydrocarbons, are based the cracking processes of McAfee, G. W. Gray, Hoover, Alexander & Taber, Danckwardt, to mention the better known ones. All of these processes involve the use of anhydrous aluminum chloride.

This substance functions as a catalyst. A catalyst is something which increases the speed of a chemical change without itself suffering any permanent change. The aluminum chloride effects the dissociation of higher boiling hydrocarbons, and the re-association of the very low gaseous hydrocarbons, catalytically, and is recoverable in many instances with but slight losses. These losses are explained later in this article.

*On the staff of the Newark Industrial Laboratories, Newark, New Jersey.

The precise mechanism of a catalyst such as aluminum chloride has never been explained with satisfaction to all. The present writers prefer to regard the action of aluminum chloride as that of a "carrier," forming a compound momentarily with the hydorcarbons, and a secondary reaction causing this highly unstable compound to decompose, leaving other hydrocarbons, some lower in boiling point and some higher than the initial hydrocarbons taking part in the reaction. In the scientific researches of Gangloff & Henderson, the latter showed conclusively that aluminum chloride and an unsaturated hydrocarbon in a solvent such as alcohol will form a definite crystalline compound. In the presence of fully saturated hydrocarbons, or hydrocarbons of the paraffin group, the aluminum chloride would cause the unsaturated hydrocarbons to condense and form a saturated hydrocarbon. The latter may therefore be termed a condensation product and is the result of the catalytic action of aluminum chloride, whereby an unsaturated hydrocarbon adds itself to a saturated one to form a saturated product.

Without Catalyst

Without the use of a catalyst, petroleum will yield, under the action of heat alone, increasing amounts of "fixed" or non-condensible gases, beginning with a temperature of about 450° F. and if heated to about 900° F., the greater portion of petroleum hydrocarbons will be decomposed and gasified, and will not be recoverable under ordinary condensing methods. If the temperature were to be raised sufficiently to crack the heavier hydrocarbons remaining after the more volatile ones have been distilled over, this high heat would have the effect of still further gasifying and ultimately decomposing the valuable oils into its elements. Aluminum chloride obviates this loss as its use permits of cracking at much lower temperatures and thus aids in the preserving of molecules resulting from cracking and still remaining in the body of oil under treatment.

The dissociation of higher hydrocarbons into lower ones may be represented by the following formula, recalling that two of the usual hydrocarbon constituents in kerosene are decane ($C_{10}H_{22}$) and undecane ($C_{11}H_{24}$):

$$C_{10}H_{22} + AlCl_3 + C_{11}H_{24} = [C_{10}H_{22}.AlCl_3.C_{11}H_{24}]$$

The latter is an additive compound, highly unstable, and breaks down immediately as follows:

(A)

$$[C_{10}H_{22}.AlCl_3.C_{11}H_{24}] = C_6H_{14} + AlCl_3 + C_{15}H_{32}$$

The C_6H_{14} or hexane is a large constituent of gasoline, and upon proper adjustment of distillation conditions, only such lower boiling hydrocarbons will be distilled over, the higher ones such as the resultant $C_{15}H_{32}$ and those as yet untouched in the cracking operation undergoing reactions similar to the illustrated one above. There is thus a progressive cracking downward until the operation is stopped. The above formulae are picturizations which are convenient in illustrating how hydrocarbons are dissociated and re-associated, using aluminum chloride ($AlCl_3$) as a catalyst. It will be noted that the aluminum chloride is regenerated in this reaction, and would be recoverable quantitatively but for certain losses which will be discussed later.

At the some time, any unsaturated hydrocarbons produced in cracking are saturated by the catalytic influence of aluminum chloride. This reaction may be simply illustrated by the following formulae:

C_6H_{12} (hexylene unsaturated) + C_6H_{14} (hexane saturated) + $AlCl_3$ = $C_{12}H_{26}$ (dodecane saturated) + $AlCl_3$

C_6H_{12} (hexylene) + C_6H_{12} (hexylene) + $AlCl_3$ = $C_{11}H_{24}$ (undecane) + $AlCl_3$ + C (free carbon)

In the first formula the product is the result of a condensation and in the second formula the products are the result of an internal condensation with the elimination of carbon. Ahe alumjnum chloride is not permanently changed. The resultant fully saturated hydrocarbons $C_{12}H_{26}$ and $C_{11}H_{24}$ then undergo cracking according to the formulae (A) given above. This cycle results in the formation of saturated low boiling hydrocarbons and very high boiling hydrocarbons and free carbon. These high boiling hydrocarbons are utilized in the production of lubricating oils and wax. Anhydrous aluminum chloride possesses the property of converting the asphalt and asphalt-yielding hydrocarbons into other bodies and very high boiling hydrocarbons thus making it more practicable to utilize the remainder of the oil for producing wax. Looking at it from another viewpoint, we may consider the action of aluminum chloride as selective, in that it holds back from the distillate the unsaturated portion of the oil.

The reasons for the necessity of saturating the hydrocarbons of petroleum products are obvious. Lubricating oils are prone to absorb oxygen from the air with the formation of asphaltic and resinous constituents, the latter causing the gumming of the oils on using or standing, and thus ruining its further use. Kerosenes containing much of the unsaturated substances are foul in odor, burn with a smoky flame and with a duller flame, and are yellow in color or become so on standing. In the case of gasoline, no such unanimity exists when interpreting the quality of gasoline from this angle. There is a constant conflict between factions who find no difficulty in producing saturated gasolines and those who find it more expensive. Below is a table showing the olefin or unsaturated content of gasoline produced by the different types of cracking processes:

1. Using aluminum chloride—essentially free from olefins.
2. Cracking at high pressures—from 5 to 20%.
3. Cracking at high temperatures in the vapor phase—from 10 to 50%.

4. Cracking by electrical means without use of "saturator"—10 to 20%.

It may be readily seen that to refine a cracked gasoline produced by means other than the use of aluminum chloride or some other saturating agent, by the usual acid treatment would entail a great loss in such gasoline as all of the unsaturated hydrocarbons would be removed and found in the sludge. There is no doubt that as the automobile engines are constructed today, the motorist would find the saturated gasoline more satisfactory as he would have less carbon deposit and a better exhaust. The public judges a gasoline by its color, its odor, and for a rapid test, by its gravity. This is unfortunate since the refiner must meet the prejudice of the consumer, whose distorted and aesthetic ideas demand a sophisticated product, by further manipulations and greater costs merely to remove slight traces of color or raise the Baume gravity one or two degrees. Hall claims that properly cracked gasoline even of the olefin group gives as good mileage as saturated gasoline as the former burns more uniformly. We reproduce tables below to show that for the same boiling points, the specific gravities of the olefins and the naphthenes are higher than that of the paraffins, or in other words, the Baume gravities are lower.

	Formulae	B.P.	Sp. Gr.
Paraffins—			
Pentane	C_5H_{12}	97° F.	3.630
Hexane	C_6H_{14}	156	0.670
Heptane	C_7H_{16}	176	0.697
Olefins—			
Amylene	C_5H_{10}	100	0.660
Hexylene . . .	C_6H_{12}	153	0.699
Heptylene	C_7H_{14}	178	0.703
Naphthenes—			
Cyclopentane .	C_5H_{10}	120	0.769
Cyclohexane .	C_6H_{12}	178	0.799
Cycloheptane .	C_7H_{14}	243	0.809

Hence, a gasoline with a large percentage of olefins or naphthenes will have a Baume gravity lower than if it were saturated, even if the boiling points are the same. This also explains why the olefins must be removed to satisfy the consumer who tests his "gas" by a hydrometer. Oils which are to be refined with acid should be saturated as otherwise not only will the losses in salable gasoline be large, but sulphonated products are formed which later cause the gasoline to change in color in transit and in storage.

In our experiments on the improvement of kerosene, we treated an export kerosene containing 8.5 per cent of unsaturated hydrocarbons and a trifle off color with two per cent of aluminum chloride by weight; this substance was of a very good grade, being over 99 per cent pure. The Aluminum Chloride was agitated in the kerosene at room temperature for one hour only. The oil after such treatment was of a reddish color which was removed by washing with water. At the same time, the slight amount of Hydrochloric Acid liberated from the Aluminum Chloride and found in the kerosene was also removed by this washing. As determined by its Iodine absorption value, the percentage of unsaturated hydrocarbons was reduced to 2.5 per cent. A second treatment under similar conditions still further reduced the percentage to 1.5 per cent, but a third treatment had no effect on the reduction. It is the general rule in chemical treatment of all kinds that the last traces of impurities are the most difficult to remove, and too often economically impractical. In the above case it is unnecessary to remove the remaining 1.5 per cent of unsaturated constituents. By treating the original kerosene at a temeprature of 150°F. for 1 hour the reduction was from 8.5 per cent to 1.5 per cent so that this temperature is more desirable than room temperature. At either of these temperatures, subsequent distillation of the finished product showed that a slight amount of cracking took place which would not be serious except for the lowering of the flash point, in some cases bringing this point below the Government requirements. The burning qualities of the treated oil was improved to the extent of decreasing of the deposit of soot in the glass chimney. The oil was water white, and did not darken on standing for a period of 6 months. A heavier oil such as lubricating oil would require longer contact with the Aluminum Chloride. The life of the catalyst is determined by the type of oil treated, the degree of unsaturation, the sulphur and moisture contents, the effectiveness of the agitation, the length of time the Aluminum Chloride is used, and its state of division. If an appreciable amount of sulphur or moisture is present in the oil, these substances will render a corresponding amount of the catalyst useless by interacting with it chemically. If the oil is highly unsaturated, the Aluminum Chloride will be "spent" more quickly by the separation of a sludge and asphaltic-like matter which surrounds the particles. Agitation should be vigorous and constant to prevent the Aluminum Chloride from settling to the bottom. The formation of the sludge around the particles of the catalyst is not as serious in the case of light oils, as these have somewhat of a solvent action thereby freeing the Aluminum Chloride from the sludge.

The chemistry of saturation and cracking by use of Aluminum Chloride has been described, and it remains for the writers to discuss some of the features of the better known processes of McAfee, G. W. Gray, Hoover, Alexander & Taber, and Danckwardt. McAfee distills off any natural gasoline and kerosene in the oil and drives off any water which might be present. Aluminum Chloride is then added to the oil to the extent of about 10 per cent by weight of the oil charge remaining. The oil is brought to a boil and the temperature of the oil maintained at no higher than 550° F. for a period ranging between 24 and 48 hours. Usually, after 48 hours, the gasoline condensate becomes negligible in quantity and the aluminum chloride loses its activity. If the dephlegmation system is properly adjusted so that all vapors leaving the still above 350° F. are condensed and returned to the still, a very high grade gasoline will result. Where the production of solvent oils in addition to gasoline is an objective, the dephlegmation temperature may be from 400 to 500° F. The gasoline vapors must be removed from the sphere of influence as soon as formed to prevent its hydrocarbons from being broken down into gases or resynthesized into high boiling hydrocarbons. The concentration of the aluminum chloride should be constant by replenishing the oil under treatment with fresh oil to the amount lost by the formation of gasoline. One part of Alum. Chloride will treat about 50 parts of oil before losing its activity. The gasoline produced is sweet, saturated, and water white. No acid is necessary in refining it. The amount of lubricating oils and the grades will depend upon how much of the oil is cracked into gasoline. A typical oil has been cracked to yield 60 per cent gasoline and 20 per cent lubricating stock. The lubricating oils will contain some Aluminum Chloride on account of their viscosities, and a small amount of acid will be necessary to remove this substance.

Although the Alum. Chloride was at first mixed with the body of oil, modifications were later made whereby it was caused to act on the oil vapors produced by ordinary distillation or distillation under pressure; and in one of his patents, McAfee describes such a process wherein he cracks oil under 60-90 pounds and treats the vapors with Alum. Chloride. The processes of G. W. Gray and of Hoover are substantially the same in principles as that of McAfee; but that of Alexander and Taber incorporates the very logical idea of conducting the cracking operations entirely in the vapor state, both the oil and Alum. Chloride coming in contact with each other as vapors. Since vapors are miscible in all proportions, the contact of the oil vapors with the catalyst is the most efficient obtainable, and assuredly more so than the Alum. Chloride in the liquid oil. The advantages which are inherent in processes of cracking in the vapor phase, are that any desired temperature, pressure, concentration, and time of contact in the reaction chambers can be used and readily controlled, and the carbon easily removed. In the general articles (See January issue) on cracking processes, the physical chemistry of vapor phase cracking was explained in detail and hence not repeated here. In their process, Alexander and Taber make provision for the sweeping of the oil vapors through the catalyst, the former carrying with it the vapors of the latter; or, the separate vapors of each may pass through different conduits and meet in the reaction chamber. Where still gases are given off in sufficient volume, these may be made to sweep through the catalyst to bring the latter into the reaction chamber, and this procedure has the advantage in that some of these still gases are reconverted into liquifiable hydrocarbons. The vapors of Alum. Chloride and oil are introduced into the base of a heated vertical retort, and the mingled vapors of cracked oil and the catalyst are withdrawn from top of the retort, cooled, the Alum. Chloride separated, reheated, and returned again to the base of the retort for further use. Danckwardt uses Carbon, Alum. Chloride and Aluminum as the catalytic agent, and causes alternately the decomposition and reformation of metal chloride by subjecting the mixture of the above 3 substances to high and relatively low temperatures, alternately, while in contact with the oil, allowing the oil to distil off by the heat of the charge.

The recovery of the aluminum chloride at the present time is of utmost importance, as upon this factor depends the successful economic and commercial value of processes using this material.

Many, Many Thanks

The REFINER wishes to thank the many subscribers who replied to our letter of May 25, telling us what they thought about The REFINER and NATURAL GASOLINE MANUFACTURER, and offering, in many instances, constructive criticism for it.

As a result of these letters our editorial department will be able to give our subscribers a better journal and no doubt has been left as to a genuine reader interest in The REFINER.

"Opening the mail" for the past week has been one of the most pleasant duties of The REFINER, and the entire staff of the journal pledges itself to increased effort toward a bigger and better REFINER.

The sentiment, as expressed by a California man, "There was a big hole and The REFINER surely fills it," was universal.

For the benefit of those who asked for more cracking process articles, our editorial department has secured the promise of manuscripts on a number of additional cracking processes, written by men who can speak with authority, and these articles should be a regular feature of The REFINER from now on.

Since the Aluminum Chloride is not yet being manufactured on a commercial scale cheap enough to permit of its being thrown away after its activity is completely lost, methods of recovering or regenerating the same are important enough to receive mention. Unfortunately, these methods are too often really re-manufacturing and thus very costly in proportion to the initial cost of the material.

The Aluminum Chloride is found in the sludge or in the coky residue. On heating this residue even beyond the normal valatilization temperature of Alum. Chloride (365 F.) the latter does not vaporize because of the protective coating of oil and coke. By preheating the residue in the still if it has not been taken down to coke, the greater portion of it is freed from oil. The residue may be heated to dull redness and a current of Chlorine gas passed through the mass, the Alum. Chloride vapors evolved, being condensed. A clay retort has been recommended, but does not stand up very well. Another method in use is to extract the aluminum chloride from the residue with water, forming a hydrated aluminum chloride; this is decomposed by heat to form Alumina and Hydrochloric Acid, the latter, in the form of a gas, then being passed over the heated Alumina in the presence of the Carbon of another portion of the coky residue, to again form Aluminum Chloride vapors. It is plain to see that this is virtually a manufacturing of the catalyst and not a recovery of active alum. chloride. Such a recovery has been made by using various solvents to either dissolve away the adhering sludge, or to dissolve the Aluminum Chloride. Some of the solvents used for the Alum. Chloride are chloroform, absolute alcohol, and chlorinated hydrocarbons. These solvents, termed activating agents, dissolve the fixed Alum. Chloride, and the latter is obtained by distilling off the solvent. This is expensive and not very efficient.

The matter narrows itself down to a question of producing anhydrous Aluminum Chloride so cheaply that its recovery for use in cracking will be unnecessary or if desirable, the total cost will still remain below a certain economical maximum point. In a study of the costs of cracking with Alum. Chloride, O. C. Ralston gives the following data to the Bureau of Mines:

Cost of Refining 1 bbl. oil	$1.00
Cost of Raw Material (crude)	2.00
Cost of Alum. Chloride (10 lbs. @ 10c)	1.00
Total Cost	4.00
Value of Gasoline (25 gals. @ 20c)	5.00
Value of Lub. Stock (8 gals. @ 25c)	2.00
Total Value of Products	7.00
Economic Margin	3.00

Ralston assumes that the Aluminum Chloride would have to be produced for a maximum of 10c per pound. We are of the opinion that when Alum. Chloride is manufactured at a figure lower than this, this method of cracking will come into universal use. The present difficulties are the production of toxic gases in manufacturing the chloride, and the proper apparatus to withstand corrosion. The writers have come in contact, and have had the pleasure of collaborating with a group of engineers who are now engaged in the final stages of the development of a process for the manufacturing of Anhydrous Aluminum Chloride of an extremely high grade, the process being free from the evolution of toxic gases; this is effected by a novel control of the feed of Chlorine. Since it is estimated that about 1,500,000,000 gallons of cracked gasoline is produced yearly at the present period, and these figures are increasing every year, over 3000 tons of Aluminum Chloride would be required every day if this method were used only in obtaining our cracked gasoline. This enormous production is not an impossibility when the varoius technical men have finally perfected their processes.

The writers wish to express their grateful appreciation for the advice and aid given them by W. F. Downs, who has devoted many years in the study and development of the technology of Alum. Chloride, and to E. R. Lederer for his aid on the subject of refining.

Kay County Gas Company Buys Engines for Station

Tulsa, Okla.—The Gas Engineering and Construction Company of Tulsa and Pittsburgh, sales agents for Clarke Brothers engines and compressors, have sold eight 80-horsepower gas engine driven compressors to the Kay County Gas Company, subsidiary of Marland Oil Company, to be installed in the company's booster station in the Tonkawa, Oklahoma, field.

The Gas Engineering and Construction Company is designing the plant for the Kay County Gas Company The deal was handled through W. G. Cummings, president, and O. B. Agner, chief engineer of the Gas Engineering and Construction Company.

Tulsa, Okla.—Steps are to be taken by the commerce counsel of the Western Petroleum Refiners Association to determine what competitive ocean rates from Gulf ports for export and coastwise movement can be paid by refining interests and to negotiate with the proper steamship rate making bodies to have equitable rates installed. This was decided on at the last meeting of the traffic comittee of the Association held in Tulsa June 7.

Texas state rates were discussed at the meeting as were the crude oil rate adjustment to St. Louis, Colorado and Kansas intermediate rate adjustment and other subjects, including the casinghead gasoline 25-cent maximum rate and the subject of removing inflammable placards from empty tank cars. P. M. Miskell, general manager of the Empire Refineries and chairman of the traffic committee, presided.

Gasoline Association Takes Up Osage Royalty Payment

Tulsa, Okla.—Conferences have been held here recently between representatives of the Association of Natural Gasoline Manufacturers and the Osage Indian Agency officials at Pawhuska, Oklahoma, relative to the basis of payment of royalties produced from Osage lands. The basis fixed by the Indian Agency on which payments are to be made are too high, in the opinion of n tural gasoline manufacturers, and an understanding is being sought.

A committee to handle this matter has been named with J. R. Freeman of the Carter Oil Company as chairman. Other members are A. T. Sherrer of Sinclair Oil and Gas; A. J. Trower of Phillips Petroleum Co.; S. C. Kearney of the Roxana Petroleum Corp.; J. D. Iams of Gypsy Oil Co., and others.

Buenos Aires, S. A.—An appeal will be taken by the West India Oil Company, subsidiary of the Standard Oil Company (New Jersey), from the recent decision of Federal Judge Zavalia who charged the company with resorting to illegal methods in extracting kerosene, gasoline and other fuels of petroleum from a mixture "by means of rapid manipulation which almost immediately produces grades that otherwise would have been subject to considerable duties."

A statement has been issued by officials of the West India Oil Company in the United States, denying the charge.

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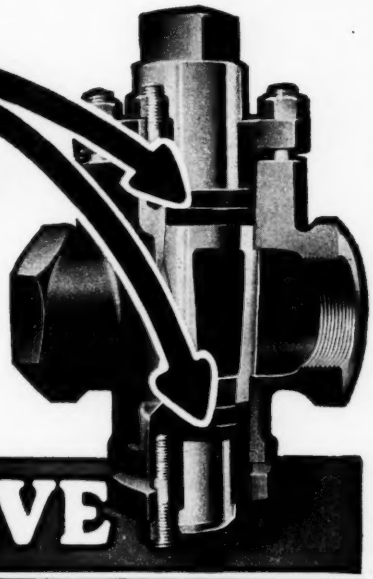

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Fire Causes Big Damage at Atlantic Refining Plant

Pittsburgh, Pa., June 20.—Late unofficial estimates as to the extent of damage done the Pittsburgh plant of the Atlantic Refining Company by fire caused from a bolt of lightning striking an oil tank the night of June 15 is placed at around $200,000.

For a time the fire was beyond control and threatened the entire works. More than a score of firemen were sent to the hospital suffering from injuries and burns caused by the flaming oil while five experts from the Franklin, Pa., works of the Atlantic Refining Company were burned about the face and hands when a large storage tank caught fire and buckled.

The Pittsburgh plant of the Atlantic covers about 21 acres and has a storage capacity of almost 500,000 barrels and employs several hundred workmen.

New Company Organized to Operate Plant Near Brazos

Fort Worth, Texas.—The Palo Pinto Oil & Refining Company has been organized by G. A. Sonricker and C. F. Johnson, owners of a 500 barrels daily capacity skimming plant near the Brazos field, Palo Pinto County, Texas, and it is planned to add to the present output of the plant, which has been operating under the partnership. Headquarters of the company is in the Security State Bank building, Mineral Wells, Texas.

Lawrenceville, Ill.—The Indian Refining Company has approved plans for the installation of five Fleming cracking process units at the company's refinery here. The M. W. Kellogg Company of New York will be in charge of the installation work.

Newkirk, Okla.—A condenser is being installed in the plant of the Sheridan Refining Company at Newkirk and other improvements are being made. The plant is running its capacity of 1,500 barrel of crude daily.

Showing the fire raging in a 30,000 barrel tank at the Pittsburgh plant of the Atlantic Refining Company. The tank was struck by lightning. Many were injured in the attempt to put it out. —Photo by International News Reel.

Pioneer Petroleum Starts Work on Smackover Plant

Smackover, Ark.—Construction work on a refinery here has been started by the Pioneer Petroleum Corporation, which has purchased the Vitek Oil and Refining Company's tank farm, consisting of some 20 acres, near here. It is expected that the plant will be in operation by July 1.

The Pioneer Petroleum Corporation will extend its present pipe line from Smackover to the east field, a distance of some 14 miles. The Pioneer company maintains sales offices at El Dorado, Ark., Guthrie, Okla., and Chicago.

British Agwi Doubles Capacity of Its Plant

London, Eng.—(By Mail) The refining capacity of the Agwi Petroleum Corporation, Ltd., of England, which was started by the Atlantic, Gulf and West Indies Steamship Lines but in which the American concern is only a minority stockholder, is to be increased to 10,000 tons weekly. The present refining capacity is 5,000 tons of heavy oil per week.

The company has formed a marketing subsidiary known as the Agwi Oil Marketing Company.

Refiners and Marketers Get Together for Co-Operation

Chicago, Ill.—Having as its object a more complete co-operation between the two organizations, a joint session of the Western Petroleum Refiners Association and the National Petroleum Marketers Association was held here May 17-19 at the Congress Hotel. J. L. Murray of Bloomington, Ill., president of the Corn Belt Oil Company, presided at the opening day's session.

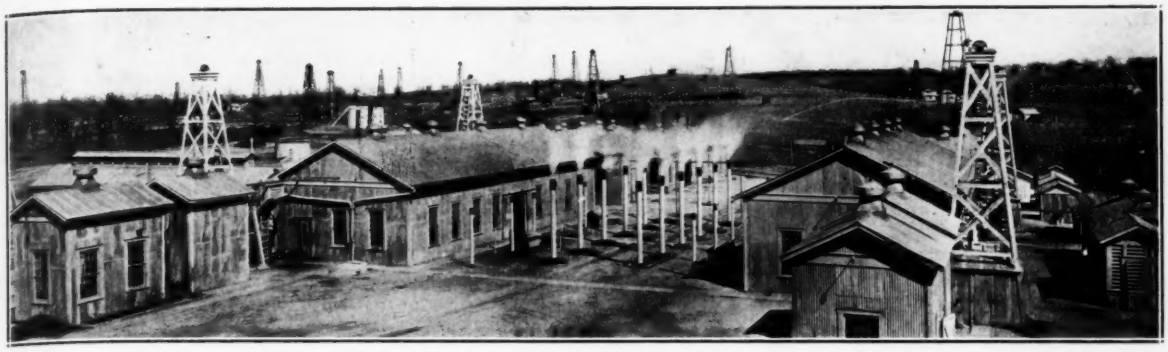
Just before adjournment it was announced that another joint meeting would be held in the near future, probably at Kansas City or some other centrally located point.

Chicago, Ill.—An offering of $800,000 General American Tank Car Corporation 6 per cent equipment trust certificates at 100 and accumulated dividends has been handled through C. D. Barney and Company and Drexel and Company.

Kansas City, Mo.—Officials of the Mutual Oil Company are on a trip through the company's distributing territory in Nebraska, Colorado, Montana, Washington and Oregon. They will also visit the refineries owned by the company in Wyoming.

Bayonne, N. J.—Every worker in the manufacturing department of the Standard Oil Company (New Jersey) is to be granted a week's vacation with pay if the worker has been in the employ of the company for one year or more.

Oklahoma City, Okla.—A charter has been granted the Blackwell Refining Company of Blackwell, Oklahoma, with a capital stock of $25,000. Incorporators are L. C. Moore, F. W. Wiles and John D. Sanford, all of Blackwell.



The Texas Company produces thousands of gallons of natural gasoline in Oklahoma daily. Here is one of the Company's plants at Drumright. —Photo by Clarence Jack, Tulsa.

Gasoline Plants of Texas Cost $16,000,000

Production of natural gasoline for April was 15,000,000 gallons; Small plant system appears to be growing in favor

By H. H. King

Fort Worth, Texas, June 20.—Representing an investment in excess of sixteen million dollars, the 117 natural gasoline manufacturing plants located in North and Central West Texas are making more than fifteen million gallons of absorption and compression gasoline each month, and have developed into an industry that has registered a remarkable and steady growth during the past two years due to the attractive profits derived from plants amply supplied with gas and operated properly. The industry is being engaged in by the major oil companies, independent oil operators and concerns, as well as individuals, who purchase gas from producing leases on a royalty or cubic foot basis. In former years the owners of gas producing wells, having gasoline content, realized only a small revenue from sale of gas for fuel, but the advent of the plants has developed a demand for the product and in some instances gas wells are proving more profitable than oil wells. Especially is this true in the Desdemona field.

The natural gasoline manufacturing industry is largely centered in three counties—Wichita, Stephens and Eastland, which have a total of 99 plants, while 18 others are scattered around in small oil fields in other counties, or on the gas line of the Lone Star Gas Company. Wichita County, with its Burkburnett and Electra fields, took the lead in erecting plants, while Eastland-Ranger and Desdemona fields in Eastland County followed shortly afterwards. Stephens County fields have been supplied with 31 plants, mostly within the past two years, and these plants have a greater combined daily gas charging capacity than any other county in the state.

The approximate cost of the 117 plants in Texas amounts to $16,970 000, and $5,205,000 of this amount is invested in 35 plants in Eastland County. Stephens County's natural gasoline industry represents an investment of approximately $5,010,000 in 27 absorption and 4 combination absorption and compression plants, while 31 compression and one absorption plants in Wichita County are credited with having cost their owners about $4,375,000, with most of the material purchased at boom prices during the war and afterwards.

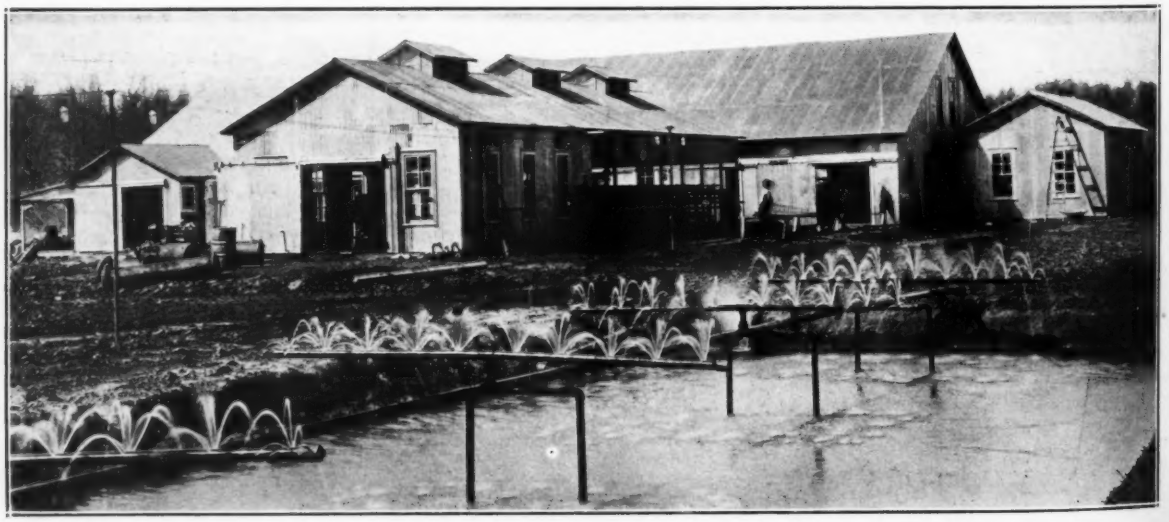
During the month of March the plants in the Eastland-Ranger section of Eastland County turned out approximately 3,720,150 gallons of natural gasoline, and the output jumped to about 4,319,910 gallons in April. In the Desdemona section of Eastland County the output for March was closely estimated at 2,263,090 gallons and the next month the gasoline production increased to 2,702,000 gallons. In the latter district the Magnolia Petroleum Company produces the major portion of the output through its five compression plants. Stephens County's gasoline output for March is placed at 3,293,650 gallons; April at 3,582,600 gallons, while May's output jumped to approximately 4,095,000 gallons. Although the gas production in the Burkburnett fields of Wichita County has declined rapidly in past few years, this section continues to rank as one of the major sources of natural gasoline due to a higher gasoline recovery per 1,000 feet, as the gas pressure drops off. Burkburnett's gasoline output for March amounted to about 3,821,580 gallons, but dropped to 3,554,460 gallons in April. The Electra field in Wichita County has lately gained in gas production as result of developments occurring in the South Electra field, and during the month of April the shipments of natural gasoline from the field amounted to 604,800 gallons.

Including the above major natural gasoline manufacturing districts and output of a number of plants scattered over the North and Central West Texas Counties, the state turned out approximately 14,459,340 gallons of raw natural gasoline in March and jumped to 15,562,680 gallons in April. The greater portion of this product is moved from the fields in insulated tank cars, while some of the manufacturers who have their own crude refineries divert the natural gasoline into crude lines to bring the gravity of the oil up before reaching the refinery. Then considerable natural gasoline is blended in the field and sold to local trade.

The Lone Star Gas Company of Dallas has three absorption plants completed with a combined daily charging capacity of 105,000,000 cubic feet, and is erecting another in Palo Pinto County that will be the largest in the state with a daily capacity of 60,000,000 cubic feet. The Lone Star Gas Company is engaged in supplying domestic and industrial gas to hundreds of cities and towns in North and Central Texas from gas fields located in Texas and Oklahoma, and has found it profitable to strip the gas of its gasoline content before it reaches the consumer. The new plant in Palo Pinto County will not only rank as the largest in the state, but will be one of the most efficient.

Many of the fields in Texas are overbuilt in certain parts with natural gasoline manufacturing plants due to the unexpected rapid decline in gas production, which has forced shut downs in several instances. Others are contemplating removal of plants to more productive sections of the field. Because of the uncertainty of gas production holding up over a long period, the majority of the plants erected lately have been of the smaller type, while the owners are inclined to hold down their investments. The use of the smaller type of plants permits removal to other gas producing areas as fields are exhausted, and it is predicted that this policy will prevail even more in the future.

Company and Sales Office Address—	Farm, Survey and Field—	Units	Process	Cubic Feet Daily Capac.
BROWN COUNTY				
Eddy Gasoline Co., P. O. Box 595, Cisco, Texas	M. M. Cox, Jose Padillo Sur. 645, N. Brown field	6	Absorption	*5,000,000
CLAY COUNTY				
Lone Star Gas Co., American Ex. Bank Bldg., Dallas, Tex.	Block 36, Parker County School Lands, Petrolia field	6	Absorption	50,000,000
Lone Star Gas Co., American Ex. Bank Bldg., Dallas, Tex.	Block 36, Parker County School Lands, Petrolia field	2	Compression	380,000
COOKE COUNTY				
Lone Star Gas Co., American Ex. Bank Bldg., Dallas, Tex.	Gainesville, Dozier Survey	6	Absorption	40,000,000
COMANCHE COUNTY				
Magnolia Petroleum Co., Magnolia Bldg., Dallas, Texas	J. N. Duke, H. T. & B. Survey, Desdemona field	2	Compression	1,000,000
EASTLAND COUNTY				
Arab Gasoline Corp., P. O. Box 997, Eastland, Texas	J. L. Johnson, Sec. 11, H. & T. C. Sur. Blk. 4, Eastland field		Absorption	6,000,000
Arab Gasoline Corp., P. O. Box 997, Eastland, Texas	E. P. Davenport, NW¼ Sec. 25, Blk. 4, Eastland field		Absorption	*5,000,000
Arkansas Natural Gas Co., Shreveport, La.	C. L. Downtain, Sec. 25, H. & T. C. Sur. Blk. 4 Eastland field	2	Absorption	5,000,000
Arkansas Natural Gas Co., Shreveport, La.	C. U. Connellee, N. Ussuary Sur., Ranger field	2	Absorption	6,000,000
Benwick Gasoline Co., P. O. Box 962 Eastland, Texas	J. R. Stubblefield, Sec. 3, H. & T. C. Sur, blk. 3, Eastland field		Compression	6,000,000
Chestnut & Smith Corp., 7th and Cheyenne Sts., Tulsa, Ok.	T. W. Duncan, M. M. Bush Survey, Ranger field	7	Absorption	4,000,000
Chestnut & Smith Corp., 7th and Cheyenne Sts., Tulsa, Ok.	E. H. Lane, M. Haley Survey, Ranger field	10	Absorption	4,000,000
Chestnut & Smith Corp., 7th and Cheyenne Sts., Tulsa, Ok.	J. T. Roper, John York Survey, Ranger field	5	Absorption	10,000,000
Chestnut & Smith Corp., 7th and Cheyenne Sts., Tulsa, Ok.	C. L. Perkins, Sec. 4, H.&T.C. Sur, blk. 4, Eastland field		Absorption	14,000,000
Cons. Gasoline Co. (Hickok Prod. Co. of Ohio), Eastland, Tex.	G. W. Martin, G. Haig Survey, Eastland field		Absorption	6,000,000
Cornite Gasoline & Oil Co., 1602 Am. Ex. Bnk. Bldg., Dallas	N. H. Jones, Sec. 43, H.&T.C. Sur. blk. 4, Eastland field	2	Absorption	*12,000,000
Crosby & Sweet, Desdemona, Texas	J. E. Crosby, T. & N. O. Sur. blk. 5, Desdemona field	1	Absorption	250,000
Desdemona Gasoline Co., 1209 F. & M. Bank Bldg, Fort Worth, Texas	Pearl Anderson, G. E. Moore Survey, Desdemona field	4	Absorption	2,000,000
Cremer-Martin Gasoline Co., 1209 F. & M. Bank Bldg., Fort Worth, Texas	J. T. Carruth, J. T. Carruth Sur., Desdemona field	4	Absorption	2,000,000
Finco Gasoline Prod. Co., Kenedy Bldg., Tulsa, Okla.	W. J. Moore, J. K. Gyle Sur., Desdemona field	4	Absorption	2,000,000
Gulf Production Co., Gulf Bldg., Houston, Texas	F. W. Taylor, Ranger field	3	Absorption	650,000
Gulf Production Co., Gulf Bldg., Houston, Texas	J. J. Kinnebrew, Sec. 29, H.&T.C. blk. 4, Eastland field	2	Absorption	10,000,000
Hall Gasoline Co. (Revere Oil Co.) 24th floor F. & M. Bank Bldg., Fort Worth	J. Salinas Survey, Desdemona field	2	Absorption	500,000
Helious Gasoline Co. (was Brown Gasoline Co.) 610 Kirby Bldg., Dallas, Texas	W. A. Eakin, W. W. Grimes Survey, Pioneer field	2	Absorption	10,000,000
Hirt-McDermott Gasoline Co., 1209 F. & M. Bank Bldg., Fort Worth, Texas	Mrs. M. E. Eppler, A. Smelzer Sur., A-431 Desdemona Gorman field	4	Absorption	2,000,000
Humble Oil & Ref. Co., Humble Bldg., Houston, Texas	E. Ellison, L. Ellison Survey, Desdemona field	4	Compression	1,500,000
Magnolia Pet. Co., Magnolia Bldg., Dallas, Texas	T. W. Connellee, John York Survey, Ranger field	4	Compression	2,000,000
Magnolia Pet. Co., Magnolia Bldg., Dallas, Texas	R. S. Harris, Mat Finch Survey, Ranger field	3	Compression	1,500,000
Magnolia Pet. Co., Magnolia Bldg., Dallas, Texas	J. W. Carruth, W. H. Funderburgh Sur., Desdemona	4	Compression	2,000,000
Magnolia Pet. Co., Magnolia Bldg., Dallas, Texas	E. C. Woodward, G. E. Moore Sur., Desdemona field	3	Ab. & Comp.	3,500,000
Magnolia Pet. Co., Magnolia Bldg., Dallas, Texas	W. R. Carruth, A Smelzer Sur. Deesdemona-Gorman	9	Compression	4,500,000
Magnolia Pet. Co., Magnolia Bldg., Dallas, Texas	J. M. Matthews, J. Salinas Sur., Desdemona field	6	Compression	3,000,000
Magnolia Pet. Co., Magnolia Bldg., Dallas, Texas	S. E. Reynolds, H. T. & B. Ry. Sur., Desdemona field	2	Compression	1,000,000
McMann Oil & Gas Co., Drew Bldg., Tulsa, Okla.	S. E. Reynolds, Sarah Bibb Sur., Desdemona field	5	Ab. & Comp.	1,500,000
McMann Oil & Gas Co., Drew Bldg., Tulsa, Okla.	J. N. Gooch, Thos. Benson Sur., Pioneer field	4	Absorption	6,000,000
Mid-Kansas Oil & Gas Co., 537 S. Main St., Findlay, Ohio	Mrs. J. P. Dabney, J. Salinas Survey, Desdemona field	2	Compression	1,000,000
National Gasoline Co., W. T. Waggoner Bldg., Fort Worth, Texas	S. D. Nelson, E. T. Ry. Co. Sur, blk. 2, Pioneer field	10	Absorption	15,000,000
Straits Gasoline Co., Desdemona, Texas	W. T. Barker, T. & N. O. Sur, blk. 1, Desdemona field	2	Absorption	500,000
Texas Gasoline Co., (Foote-Nolen), 1209 F. & M. Bank Bldg., Fort Worth, Texas	N Bearden, J. Salinas Sur., Desdemona field	2	Absorption	1,000,000
Universal Products Co., Eastland, Texas	H. C. Earnest, Sec. 3, blk. 4, H.&T.C. Sur., Eastland	2	Absorption	1,000,000
ERATH COUNTY				
Magnolia Pet. Co. Magnolia Bldg., Dallas, Texas	J. T. McMillan, J. K. Gyle Sur., Desdemona field	3	Compression	1,500,000
PALO PINTO COUNTY				
John C. Burkett, Mineral Wells, Texas	R. A. Wheeler, Brazos field		Absorption	*2,500,000
Lone Star Gas Co., Am. Ex. Bank Bldg., Dallas, Texas	Taylor-Gilbert, George Green Sur., Brazos field	3	Absorption	15,000,000
POTTER COUNTY				
Cannon Gasoline Co., Amarillo, Texas	SW¼ SEc. 159 A. B. & M. Sur., Blk. 2 near Amarillo	6	Absorption	20,000,000
SHACKELFORD COUNTY				
Empire Gas & Fuel Co. Bartlesville Okla.	D. C. Brazell, NW cor Sec. 52, B. A. L. Sur., Ibex field		Absorption	*10,000,000
Landreth Gasoline Co. First Nat. Bank Bldg., Breckenridge, Texas	Wm. Poindexter, Sec. 28, B. A. L. Sur., Ibex field	3	Absorption	*12,000,000



Among the properties taken over by the Transcontinental Oil Company in Oklahoma in the deal with the Riverside Western Oil Company was a natural gasoline plant near Nowata. —Photo by Clarence Jack.

Lubrication–Its Chemical Causes and Features

Some interesting facts excerpted from a scientific discussion on the chemistry of lubrication

By A. E. Dunston and F. B. Thole *

During the last few years rapidly increasing attention has been directed by chemists and physicians to the study of lubricating oils. The former have attempted to obtain some knowledge of the various types of hydrocarbons in the oil and their physical and chemical characteristics; the latter have endeavored to elucidate the why and wherefore of lubrication and the most recent researches have tended to develop along the line of contact of the two sections of the investigation.

The chief points so far elucidated regarding the chemistry of mineral lubricating oils are:

(1) It appears beyond doubt that the high-boiling fractions of petroleum, irrespective of their place or origin, are complex mixtures containing but a small percentage of paraffine hydrocarbons of the formula C_nH_{2n} plus, and consisting chiefly of compounds whose formulas range from C_nH_{2n} to C_nH_{n-8}. A few of these compounds have been isolated by Mabery, by repeated fractional distillation of crude American oils, even from a crude so pronouncedly paraffinoid in nature as Pennsylvania oil.

(2) In no case has the chemical constitution of a component of a lubricating oil been established, but the chemical behavior of these oils indicates that among the components are unsaturated hydrocarbons (possibly open-chain, but more probably naphthenic and polynuclear, or perhaps both types), saturated hydrocarbons (naphthenic and probably to some extent polynuclear, but not to any appreciable extent paraffinoid), and aromatic hydrocarbons (to an unknown and probably a limited extent), together with small amounts of sulphur —and oxygen-containing compounds, the latter of which can be isolated and are probably the principal cause of gumming.

(3) "Unsaturated" compounds constitute between 20 per cent and 40 per cent of most lubricating oils, and are in part removed from the oil by agitation with concentrated sulphuric acid.

Brooks and Humphrey have shown that the higher simple olefines are polymerized by concentrated sulphuric acid yielding a colorless condensation product which is insoluble in the acid but soluble in hydrocarbons. Small amount of carbinols, and acid and neutral sulphates are also produced. It follows, therefore, that the olefine contents of a hydrocarbon mixture cannot be determined volumetrically by extraction with sulphuric acid.

When lubricating oils are shaken with concentrated sulphuric acid, a heavy tarry mass separates which soon becomes solid. It seems doubtful, therefore, if lubrication oils contain more than a small percentage of true olefine hydrocarbons. This conclusion is strengthened by the fact that, so far as our experience goes, attempts to hydrogenate such oil by the Sabatier method have uniformly failed. It would therefore appear that the nature of the unsaturated bodies in lubricating oil is at present an unsolved problem.

A partial separation of these unsaturated hydrocarons from the saturated ones which does not involve their destruction can be achieved by employing their superior solubility in liquid sulphur dioxide. Thus a lubricating oil with an iodine value of 46 on extraction with liquid sulphur-dioxide gave a residue with iodine value 33 and an extract with iodine value 73.

A similar effect can be achieved by filteration through Fullers earth, a material which absorbs unsaturated compounds to a greater degree than saturated compounds. Neither method is sufficiently discriminating to be of use in effecting even an approximate separation of the two types.

The curious iodine value results given by lubricating oils seem to indicate that the unsaturated compounds attacked by sulphuric acid and by formaldehyde do not react readily or normally with iodine.

The reaction of mineral oils toward iodine differs profoundly from that of fatty oils. Experience in the determination of iodine values by means of Wijs' reagent has indicated that by varying the time and proportion of iodine chloride a given mineral lubricating oil may yield widely varying values. For example, a California mineral oil gave a value of 20 in 2 hours, 40 in 4 hours, 60 in 64 hours, and 80 in 266 hours, whereas rape oil reached a steady value in 3 minutes. Again, the iodine value of rape oil was found to be practically independent of the amount of Wijs' solution used (provided a fair excess was employed), but with the mineral lubricating oil an increase in the proportion of reagent to oil invariably augments the iodine value.

The interpretation of these results is difficult when coupled with the reluctance exhibited to hydrogenation; unsaturated glycerides of comparable molecular weight behaved quite normally in both respects.

The facts again seem to lead one to the conclusion that the "unsaturated" hydrocarbons in mineral oil consists to a small degree only of true olefines. The sluggish reactivity of the greater part may be due to the somewhat slow and difficult rupture of closed ring systems, which can be brought about by the drastic action of sulphuric acid and Wijs' reagent respectively, whereas the milder action of hydrogen and nickel fails to operate.

Naphthenic, Aromatic and Resinous Compounds

(4) Analysis indicates that the residual saturated compounds after treatment with concentrated sulphuric acid are principally naphthenic, and most

FIFTEEN 165 H.P. "BESSEMER" GAS ENGINES DRIVING GAS COMPRESSORS AT PLANT OF INDUSTRIAL FUEL SUPPLY CO., PLACENTIA, CAL.
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The Industrial Fuel Supply Company at Placentia, California, is utilizing every fraction of power in the fuel which it distributes, by extracting the gasoline from the gas which it supplies for commercial uses. In connection with its booster station, it has developed a refrigeration system which it operates in connection with the compression of gas for storage and for direction through its lines, extracting the condensible fractions without detracting from the value of the gas as a heat producer. The photo shows fifteen 165 h. p. Bessemer gas engines on duty driving the gas compressors at this plant

*Chemical and Metallurgical Engineering, Feb. 14, 1923, p. 299.

probably polynuclear in structure, since they contain less hydrogen than is demanded by the simple naphthenic formula, Cn H_{2n}.

(5) The presence of aromatic hydrocarbons is possible, but has not been definitely proved. By nitration, nitro-derivatives are obtainable; the reduction product from these will, however, not yield azo-dyes, so the nitro-compounds may not be aromatic in type.

(6) Resinous components have been shown by Holde to be present to the extent of a few tenths of a per cent, and to be capable of separation from the hydrocarbons by treatment with alcohol and ether. They are solid, oxygen-containing, lac-like bodies, and are probably an important cause of "gumming," since they would tend to accumulate as the hydrocarbons in oil evaporated. Moreover, the hydrocarbons thus purified showed no tendency to gum on prolonged exposure to heat and air. Holde's statement would appear to go too far. The removal of these bodies reduced the gumming tendency. Removal of unsaturated hydrocarbons still further reduces it, but even the saturated hydrocarbons oxidize appreciably on exposure to air and heat.

Viscosity

The actual influence on the viscosity of the oil of the differences in chemical nature of the different components has been stated by several workers, the statements being in some cases contradictory. Mabry and Matthews have published figures which indicates conclusively that an increase in viscosity occurs concurrently with a decrease in the hydrogen content, pariffines being comparatively very mobile and ineffi.cient in lubricating powers, while hydrocarbons of the formula CnHn—$_6$ are said to be as viscous and as efficient as sperm oil.

It is a well known fact that paraffines are comparatively poor lubricants, while oils such as medicinal paraffine and vaseline, which have been submitted to vigorous refining by acid or filtration generally with the object of decolorizing, are inferior in viscosity and in lubricating efficiency to those which still contain a certain proportion of unsaturated hydrocarbons. The oil refiner should therefore carefully regulate the treatment so as to remove as far as possible the oxygenated compounds and the more highly reactive of the unsaturated hydrocarbons, which are chiefly responsible for gumming and carbonization, while destroying only a minimum of those more stable unsaturated hydrocarbons the presence of which in the oil is an asset.

Kramer and Spilker have synthesized condensation products from methylated benzenes and alkyl alcohol, which possess extremely high viscpsity, and are in fact synthetic lubricating oils. For example with meitylene as a starting-out material, they have made:

$$(CH_3)_3C_6H_2—C(CH_3)_2—C_6H_2(CH_3)_3$$ or $C_{21}H_{28}$; i. 2, CnH_{2n-14}.

This compound has a specific viscosity of over 700. They consider that such odies are the true "viscosity carriers" in luricating oil and that the high viscosity is due to the accumulaiton of methyl groups.

R. H. Brownlee has recently shown that a hydrocarbon oil of high flash point and viscosity and very low cold test, suitable for lubrication, is obtained by the polymerization of light unsaturated hydrocarbons by agitating them with a catalyst preferably at 200 to 400 deg. F. As catalysts anhydrous aluminum chloride, or a halide or reagents which produce in the nascent state, are used. The oil, after treatment, is washed and distilled with steam. The distillates include products having the flash points of naphtha and kerosene, and a variety of lubricating oil fractions.

(8) The influence of physical conditions on the viscosity of luricating oils, especially as regards preliminary heat-treatment, was pointed out long ago by Bender, while the recognition of colloidal components in machine oil by Schneider and Just brought lubricating oils into line with other colloids as regards the well-known manifestation of temperature-viscosity hysteresis. Heavy mineral oils must undoubtedly be iso-colloids, i. e., polyphase systems in which the dispersed component is of the same chemical nature as the dispersion medium. Just as water must be regarded as a system in which molecules such as $(H_2O)3$ coexist with simple H_2O molecules so in a lubricating oil the disperse phase is a

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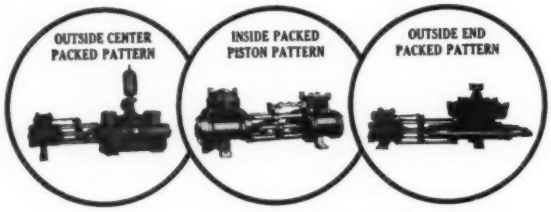

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Property of "Oiliness"

(9) The vital importance of maintaining the film of lubricant between shaft and bearing necessitates that mysterious property known as "Body". Perhaps no property has been discussed so assiduously among lubrication experts as this. Archbutt and Deeley refer to this as "oiliness" and indorse the opinion of Wilson that in reality, oiliness or body is a function both of viscosity and of capillarity. Unfortunately there is little experimental record on the surface tension of mineral oils, but there is a very close relationship between the two properties to which reference has been made. Both are conditioned by the play of intermolecular forces, and both are intimately affected by association and unsaturation.

It is not improbable that some connection exists between body and molecular weight. When it is realized that the triglycerylester of ricinoleic acid, which is present in castor oil, has a molecular weight of 932, whereas that of Russian engine oil is 426, it is reasonable to expect a much higher value for the molecular volume in the fatty oil. This enhanced value shows itself not only in high viscosity, but also in "oiliness".

Granted that lubricating oils are isocolloids, it is possible that this mysterious oiliness or body may be dependent on the degree of dispersion by the particular oil.

In recent years the property of "oiliness" has become associated with the presence of unsaturated compounds which constitute 20 to 40 per cent of most lubricating oils.

W. B. Hardy concludes that lubrication depends wholly on the chemical constitution of a fluid; the fact that the true lubricant is able to render slipping easy when a film of only about one molecule deep is present on the solid faces suggests that the true lubricant is always a fluid which is adsorbed on the solid face, such adsorption being dependent on the attractive forces associated with unsaturated compounds. It follows that lubrication is merely a special problem of colloid physics. A surface saturated with a film of condensed matter (ordinary glass, for example, possesses a film of grease on the surface with a depth of 100 molecules) differs from one with a cleaned or raw surface. The surface of water after scraping has a higher surface tension and is highly adsorptive. Vigorous rubbing of a glass surface under water with the finger tips until a clinging feel is produced yields a fresh surface which possesses peculiar properties such as "seizing" when in contact with a similar fresh surface.

Deeley has measured static co-efficients of various oils between metals. When no lubricant is used the static coefficient increases as the surfaces continue to rub against each other. Such clean surfaces are very sensitive to contamination influences e. g. moisture. It is interesting to note that the oils which have the smallest coefficient of friction are those which have proved the best lubricants in practice. It would appear that the unsaturated molecules of the lubricant enter into a firm physicochemical union with the metallic surfaces, forming a friction surface which is a compound of oil and metal. This surface would also appear to be of more than molecular thickness. Thin films of this kind can not be removed by merely wiping, but must be ground off under water, or a thin layer of metal must be cut off.

Fatty Acid Blending

H. M. Wells and J. E. Southcombe consider that the superiority of a blended or compounded oil is due to the presence of a small amount of free fatty acid, either pre-existing in the added saponifiable oil or formed therefrom by hydrolysis. They therefore propose to prepare luricating oils by adding to mineral oils such a quantity as 1 to 2 per cent of free fatty acid. Acids of low molecular weight such as butyric and cinnamic acids results in the formation of a non-emulsifiable oil, while the acids of high molecular weight like those obtained from whale oil, wool grease, etc., from emulsifiable oils suitable for marine lubrication.

During the past year these workers have continued the development of their views on the influence of small amounts of fatty acids when dissolved in mineral oils. They emphasize the distinction between the lubrication of fast-running shafts with a large excess of oil where the frictional values are a function primarily of the oil viscosity, and that of slow speed machinery with high bearing pressure, where viscosity measurements no longer assist in the choice of the lubricant. They have found that the interfacial tension against water of vegetable and animal oils was very much lower than that of a mineral oil, and this lowering was due to the slight content of free fatty acid in the fatty oils; but removing the free fatty acids from the saponifiable oils the tension rises, and by adding free fatty acids to the mineral oil the tension can be lowered. It follows that if a substance be added to an oil which brings about a lowering of interfacial tension, such addition will act favorably as far as lubrication is concerned by preventing a rupture of the liquid film and consequent direct contact between the metals.

In point of fact, Archbutt concludes from experiments which he has recently communicated to the Physical Society that the addition of 1 per cent of free fatty acids to a mineral oil lowers the frictional coefficient to the same extent as does 60 per cent of pure rape oil, and thus lends support to the contention that it is not the glyceride, but the free fatty acid in a oil which improves its lubricating value. The theory that the action of the fatty acid is due to the fact that the interfacial tension between oil and water and between oil and mercury is greatly lowered by the addition of fatty acid to a mineral oil has met with criticism, and it has been pointed out that, although neutral rape oil added to mineral oil greatly reduced the friction coefficient, the interfacial tension between neutral rape oil and water was nearly as high as that between mineral oil and water. In the lubrication of a shaft or journal running at a fairly high speed and under moderate pressure, the bearing is separated from the journal by a film of oil, and the friction is solely due to the viscosity of the lubricant. That property of a lubricant which is not viscosity and is termed "oiliness" becomes important only when the conditions are such that solid or "contact" friction occurs, and all recent work points to the fact that it is the chemically reactive unsaturated constituents of lubricants which promote "oiliness" and that they do so by entering into physicochemical union with the solid faces lubricated, forming new composite surface with lower surface energy and opposing less resistance to shear than the unlubricated surfaces. The greater activity of free fatty acids is quite in accordance with this theory.

Vegetable and Animal Oils

(10) It will be manifest from the foregoing brief summary of our present knowledge on this subject that a very wide and extremely important and absorbing field of research is open not only with reference to mineral oils, but including also the vegetable and animal lubricating oils and perhaps synthetic

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compounds of known composition and ascertainable lubricating efficiency.

The number of lubricating oils derived from vegetable and animal sources is limited, and the chemical constitution of these oils, with some exceptions, is fairly well known. They are composed of the esters of trivalent and unsaturated fatty acids. The particular esters contained in the different oils and fats have to a large extent been identified, and their quantitative proportions can in some cases be stated approximately. Further research is most needed in the case of the sperm oils, the particular alcohols and acids of which are still quite unknown. Castor oil also needs further investigation. The number of different esters in each vegetable and animal oil is comparatively small. The oil or fat yielded by each kind of seed or animal tissue is sufficiently uniform in composition for its lubricating value to be known from past experience. The knowledge that we lack in the case of these oils is the relative luricating values of the indvidual esters composing them, and as all the natural oils are mixtures, it is desirable that the pure esters should be prepared and their lubricating properties determined.

With mineral lubricating oils the circumstances are entirely different. The number of these oils is very large, and our knowledge of their composition very incomplete. We know that they consist in the main of hydrocarbons of different series, some saturated and others unsaturated. We know broadly but very incompletely, the principal series of hydrocarbons existing in the lubricating oils that are manufactured from the crude petroleum obtained from the different oil fields, but we have no knowledge of the quantitative composition of these oils nor of the chemical constitution of any of the particular hydrocarbons composing any particular oil. We are also possessed of very little information as to the relative lubricating values of the different series of hydrocarbons. If the number of mineral lubricating oils were as limited as that of the vegetable and animal oils, if they were definite products like the oils naturally ocurring in vegetable and animal tissues, it would not be a difficult matter to learn by experience the lubricating value of the different oils, and a knowledge of their constitution would then be of secondary importance to the user of lubricants. But the variety of mineral lubricating oils is so great and their composition so variable and so dependent upon the process of manufacture that it is a matter of the utmost importance for us to be able to analyze these oils.

For this purpose it is desirable to determine the nature and relative proportions of their constituents, and also to separate the main constituents from each other and determine their relative value as lubricants.

Suggested Research Program

The main lines on which research is needed may be summarized as follows:

(1) To isolate and determine the nature of the hydrocarbons in mineral lubricating oils which especially promote the properties of viscosity and "oiliness."

(2) To determine the classes of hydrocarbons desirable in lubricants required to work under high pressures and high temperatures, particularly as regards their relative stability under the condition obtaining in internal combustion engines, steam engines and air compressors.

(3) To study the causes and means of preventing the formation of carbonaceous deposits from the lubricating oils under the conditions named in 2, with special reference to the nature of the hydrocarbon and non-hydrocarbon constituents of such oils.

(4) To study the causes of emulsification in circulating oiling and in splash systems, with special reference to (a) the influence of the oxy and thio-compounds in mineral oils, and (b) the characteristics of oils with non-emulsifying properties.

(5) To study the causes and conditions of oxidation of hydrocarbons at elevated temperatures.

(6) To determine the direction in which the processes of manufacture can be modified so as to lead to the production of lubricating oils of improved types.

(7) To discover new methods of analysis that will enable the chemist when examining a lubricating oil in the laboratory, besides determining its viscosity, specific gravity, flash point, etc., to determine the constituents of the oil with the help of the knowledge gained under 1 to 5 to measure its ability to reduce friction and to meet the conditions of speed, load, temperature, atmosphere in which it is required to work. Much of this information can be ascertained today only by the costly method of trial.

(8) To elaborate further methods of producing lubricants synthetically in order to meet special requirements. Dicresylcarbonate, for example, has been used as a lubricant. Reduced naphthenes, glycerides of napthenic acids and cinamenes have been prepared and shown to have lubricating value. It might be found possible to produce lubricants whose rate of change of viscosity is less and whose freezing point is lower than is the case with existing lubricants.

(9) To prepare in a pure state the esters met with in animal and vegetable lubricating oils and determine their relative lubricating values.

(10) To investigate the claim that the free fatty acids present in commercial fixed oils are the active constituents which enable these oils to improve the lubricating value of mineral oils, and to investigate further whether the addition of such acids to mineral oils may have any deleterious effect.

(11) To investigate the colloidal nature of lubricating oils and its bearing upon lubricating problems.

(12) To study the effect of ultra-violet light, sunlight and ozone upon lubricating oils.

(13) To investigate the phenomena of dissimilar surfaces (oil and metal) in contact, especially in relation to the property of "oiliness."

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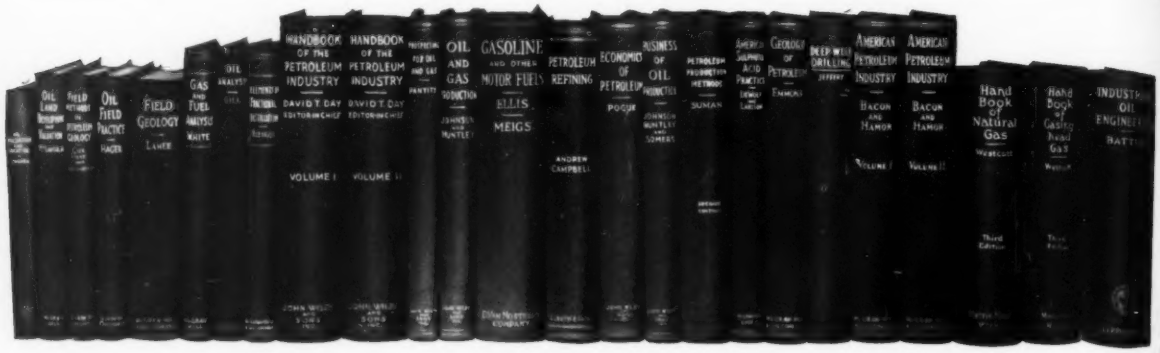

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PERSONNEL OF THE INDUSTRY

L. C. McClure, at one time connected with the Panhandle Refining Company of Dallas, Texas, and later with the States Petroleum Products Company of Kansas City, now is associated with the Sterling Oil and Refining Company with headquarters at Wichita, Kansas.

W. B. Caward, general sales manager of Producers and Refiners Corporation has been elected a member of the board of directors of the Hawkeye Oil Company of Waterloo, Iowa, distributing subsidiary of Producers and Refiners Corporation in northern Iowa and Minnesota.

O. Kelly, formerly with the Interstate Pipe Line Company at Dallas, Texas, has been appointed Mid-Continent representative of the Victory Manufacturing Company of Niles, California, and will make his headquarters in Wichita Falls, Texas, for the present time.

F. A. PIELSTICKER

of El Dorado, Kansas, for several years connected with the Midland Refining Company, has been elected vice president of the Skelly Oil Company.

Arthur E. Biggs, representing Victory Manufacturing Company of Niles, Calif., has just returned from a tour of the Mid-Continent, Texas and other points. He visited the oil fields and refineries in the Los Angeles district about the middle of June.

L. M. Lingenfelter, sales manager in charge of the Southwestern district offices of the Miller Petroleum Company at Dallas, Texas, has been transferred to Milwaukee to take charge of the company's district sales office. R. B. Miller of Kansas City has succeeded Lingenfelter at Dallas.

T. W. Rhoades, superintendent natural gasoline manufacturing department, Gulf Production Company in Texas with headquarters at Ft. Worth, and Miss Bettie Dickerson of Wichita Falls were married recently at Oklahoma City, and are now making their home at Fort Worth.

A. J. Schlosser, general superintendent of the gasoline division of the Barnsdall Oil Company, was the recipient of an engraved cigar case presented to him by Barnsdall employes on the occasion of his birthday.

W. R. Spann has announced his resignation as president and general manager of the Montrose Oil Refining Company of Fort Worth, Texas, and also as secretary of the Invincible Oil Company. He will become president of the National Gasoline Company, a $5,000,000 Delaware corporation.

F. A. Pielsticker, vice president and manager of the Midland Refining Co., has been elected vice president and director of the Skelly Oil Co., succeeding Jonh A. G. Nilsson, who resigned as treasurer and director. F. T. Hopp was elected treasurer to succeed Nilsson.

J. A. Grubb, district manager in charge of the Fort Worth offices of Black, Sivalls & Bryson, Inc., tank makers, was a visitor in Wichita Falls last week and later departed for a trip through the Panhandle district.

H. R. Barnard, vice president of Sinclair Oil and Gas Company, was in the Kansas gas fields recently making arrangements for obtaining a supply of gas for the company's natural gasoline plants.

H. I. Miller, district sales manager of the Detroit Graphite Company of Detroit, Mich., manufacturers of industrial paints "in all colors for all purposes," has completed a tour of the Mid-Continent refining field.

C. P. Nissen, traffic manager of the Sterling Oil and Refining Company of Wichita, Kansas, believes he holds the record for the longest commercial trip. He recently covered a distance of 2,470 miles by airplane, from Wichita to Buffalo, N. Y., and return, transacting business on the way in Kansas City, St. Louis, Dayton, Cleveland, Sharon, Pa., Buffalo, Niagra Falls, Detroit, Chicago, Bloomington and Decatur, Illinois.

Arthur E. Biggins, representative of the Victory Manufacturing Company of Niles, California, recently completed a business trip through the Mid-Continent refining field.

D. E. Buchanan, for the last three years sales manager of Chestnut and Smith Corporation, has been elected a vice president and director of the company and will be in charge of the entire manufacturing end of the business. He succeeds Thomas P. Melvin, resigned.

E. O. Mullin, salesman for Dean E. Foster, consulting engineer and manufacturer of the Foster Baffle for gasoline plants, has returned from a month's business trip through Texas, Arkansas and Louisiana. Mr. Mullin reports a successful trip.

George B. Williams, sales manager of Johnson Oil Refining Company of Chicago was among those attending the recent meeting of Wisconsin oil jobbers at Milwaukee.

General American Tank Car Corporation announces the resignation of C. H. Dyle as vice president and director of purchases. Lester N. Selig has been appointed assistant to president and acting director of purchases and R. M. McFarland assistant purchasing agent.

Producers and Refiners Corporation through H. E. Johnston, general sales manager, announce the following appointments in the sales department of the company: Walter B. Caward, assistant general sales manager with headquarters in Chicago; R. W. McDowell, assistant sales manager with headquarters at Tulsa, Okla., and L. U. Wagner, assistant sales manager with headquarters at Denver, Colo.

J. W. Kirkbride has been named Tulsa representative of the American Paint and Supply Company of Dallas, Texas, manufacturers of industrial paints.

J. W. Smith, sales manager of the eastern division of the White Oil Corporation has severed his connection with the company, effective on or about June 1.

R. W. Gordon, engineer in charge of natural gasoline plant No. 108 in the Ranger, Texas district for the Chestnut & Smith Corporation, has been appointed assistant superintendent of the Ranger division following the resignation of R. W. Thomas.

RECENT REFINERY PATENTS ISSUED

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the oil refining industry were recently issued by the United States Patent Office at Washington:

No. 1,543,479. A patent on a new process of treating hydrocarbon oils issued on May 1 to John P. Persch, assignor of one-fifth to Brainard Tolles, Hohokus, Texas. It consists of the process of reducing the viscosity of hydrocarbon oils consisting in placing the oil to be treated in a large container, forcing a gaseous fluid through a nozzle into the oil to atomize the oil at the nozzle, confining the atomized oil and fluid in an open ended pipe and causing the mixed fluid and oil to pass through the pipe whereby the fluid is brought into intimate contact with the consecutive small portions of the mass of oil in a restricted space, conducting away the gaseous fluid after it passes through the pipe and delivering the oil back into the main body of oil and continuing the operation until the whole mass of oil is acted upon and its fluidity increased.

No. 1,454,142, issued on May 8 to Harry A. Wier and Stuart A. Wier, of Dallas, Texas, on a means of cracking hydrocarbons. The apparatus comprises a still housing having a combustion chamber in its bottom, an approximately horizontal main still disposed within the still housing above the combustion chamber with its sides disposed adjacent the side walls of the still housing, said main still terminating at a point spaced forwardly from the rear end wall of the still housing, providing an upstanding gas passage, an approximately horizontal secondary still arranged in the still housing above and spaced from the main still with its ends projecting through the end walls of the still housing, upstanding pipes connected with the top of the main still and extending through the bottom of the secondary still into the same and terminating above the bottom of the secondary still, and a condenser connected with the upper secondary still.

No. 1,454,485, issued to John P. Persch, of Houston, Texas, assignor of one-fifth to Brainard Tolles, Hohokus, N. J., consisting of an apparatus for treating heavy oils to facilitate their passage through long substantially horizontal pipe lines comprising a section of the pipe line, tubes to supply gas to the section, means to heat the tubes, means to regulate the temperature of the supplied gas, and means to mix the gas and oil while in the pipe line and to force the mixture through the pipe line.

No. 1,454,593, a patent on a method of purifying mineral oils, issued on May 8 to Edward E. Arnold, assignor to the Nitrogen Corporation, Providence, R. I., a corporation of Rhode Island; which is the step which comprises treating a mass of said oil with liquid anhydrous ammonia in the presence of an alkalinous metal oxygen bearing compound which serves as an oxidizing agent thus causing the sulphur present in said oil to combine with said ammonia under oxidizing conditions to form an ammonia-sulphur-oxygen compound.

No. 1,454,705, issued on a method of extracting oil, on May 8 to Frank P. Croft, Philadelphia, Pa. The method consists in coarsely grinding oil-bearing material; heating said material to remove practically all of the moisture therein; grinding said material to a relatively fine form; and then subjecting said material to a relatively high pressure to express the oil therefrom.

No. 1,455,376, a patent on a process of converting oils, issued on May 15 to Joseph H. Adams, assignor to the Texas Company, Houston, Texas, a corporation of Texas. It consists of a continuous process of the nature disclosed for transforming high boiling hydrocarbon oils into lower boiling products consisting in preheating oil to a temperature below vaporization, continuously atomizing and spraying it downwardly under pressure into a

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3504	9/16	7/8	11/32	29/64	1.50
3505	5/8	1	13/32	33/64	1.50
3506	11/16	1-3/32	7/16	9/16	1.50
3507	3/4	1-3/16	31/64	39/64	1.50
3508	13/16	1-9/32	33/64	21/32	1.50
3509	7/8	1-3/8	35/64	45/64	1.50
3510	15/16	1-15/32	19/32	3/4	1.50
3511	1	1-19/32	41/64	13/16	1.75
3512	1-1/8	1-3/4	45/64	57/64	2.00
3513	1-1/4	2	51/64	1-1/32	2.25

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chamber and against an element in said chamber heated to a cracking temperature, spraying superheated steam into said chamber continuously towards said heated element, passing the vapors generated upward through an enlarged vapor dome whereby unconverted portions will flow back to the vicinity of said heated element, passing vapors from said dome through a condenser in open communication therewith and maintaining substantially the same superatmospheric pressure throughout the operation in said chamber, dome and condenser.

No. 1,455,377, issued on May 15 to Joseph H. Adams, assignor to the Texas Company, Houston, Texas, a corporation of Texas. The patent consists, in an oil treating apparatus, the combination with means for spraying oil in atomized or finely divided form into a closed chamber under pressure, means disposed outside said chamber for preheating the oil to a comparatively high temperature below vaporization, a heating member within the chamber adapted to subject the compressed atomized oil to a cracking temperature, and means for condensing converted vapors under superatmospheric pressure.

No. 1,456,392, a patent on a retort for the treatment of carbonaceous or other materials, issued on May 22 to Frederick Deacon Marshall, Westminster, London, England. This is a retort for drying, roasting, calcining or distilling carbonaceous or other materials, comprising a plurality of baffles or shelves disposed around the interior of the rotating cylinder or retort chamber, one end of said shelf being attached to the inner face of the retort chamber and the other end projecting inwards towards the interior, the arrangement around the periphery of the several shelves of each row being such that each shelf is disposed approximately along a chord of the retort chamber so as to deposit or shower the material raised by one shelf upon the surface of the shelf immediately in advance of it, at a point well beyond a vertical plane through the axis of the retort.

No. 1,456,419, a patent on a process and apparatus for the production of low boiling point hydrocarbons issued on May 22 to John C. Black, Destrehan, La. The patent comprises, in an apparatus for treating oil, a source of supply, heating coils and connections between the supply and coils, an oil bypass trap, a discharge tank and discharge connections from the coils to the trap and from the trap to the tank, said supply connection and discharge connections having a by-pass between them with a valve therein whereby the supply of oil may be switched from the supply to the discharge connections without passing through the coils or trap.

A process of cracking hydrocarbons which comprises forcing them through preliminary heating coils arranged in series relative to each other, where the hydrocarbons are heated to substantially the maximum temperature to be employed in the cracking operation, then passing them through a final heating coil wherein the temperature is maintained at the said maximum temperature and heat is supplied to the hydrocarbons to at least equal that rendered latent by the endothermic reaction of the cracking, thereby subjecting the hydrocarbon to a prolonged period of heating at said maximum temperature whereby substantially maximum conversion is obtained for the temperature employed and time of reaction, then passing the hydrocarbons to a carbon precipitating chamber wherein the rate of flow of the hydrocarbons is reduced to permit of the separation of the carbonaceous material of reaction while the hydrocarbons are maintained under sufficient pressure to maintain them in a liquid state whereby the carbonaceous material is deposited in a condition easily removed, then discharging them through a pressure regulating valve into a fractionating apparatus to separate the hydrocarbons of different boiling points.

No. 1,457,068, a patent issued on May 29 to Henry M. Lasher, Kansas City, Missouri, assignor to the Kansas City Gasoline Company, Kansas City, Kansas, a corporation of Kansas. The patent is on a process of cracking petroleum oil which consists in heating the same to cracking temperature at low pressure with a subdivided mass of sodium chloride suspended in the liquid.

Baltimore, Md.—Negotiations are under way between the Davison Chemical Company and the Mexican Petroleum Company for the Silico-Gil process, although nothing in the way of a contract or agreement has been entered into. Mexican Petroleum officials state that they have been "looking into" the Silico-Gil process for about two years as have other companies, but that there is nothing official to put out at this time.

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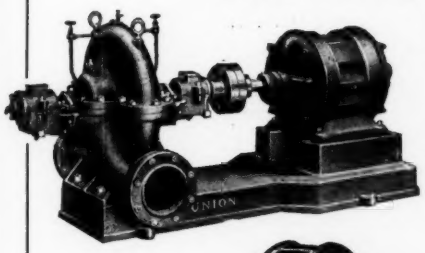

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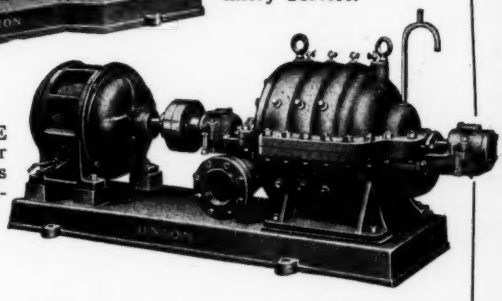

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Ford Oil & Ref. Co., Kansas City	500	*
St. Joseph Vis. Oil Co., St. Joseph	500	†

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Company and Location—	Daily Capacity	Now Running
Assd. P. & R. Co., El Dorado	1,000	*
Bell Prod. & Ref Co., Wichita	700	*
Com'wealth O. & R. Co., Moran	800	200
Derby Oil Co., Wichita	5,000	2,500
Chem. O. & G. Co., Osawatomie	1,000	*
El Dorado Ref. Co., El Dorado	4,000	2,500
Mecca Ref. Co., Augusta	2,500	*
Fontier Ref. Co., Hutchinson	2,000	1,000
Fugatt Giles Corp., Wichita	100	*
Golden Rule Ref. Co., Wichita	800	600
Great Western Ref. Co., Erie	1,500	*
Great Western Pet. Co., Florence	2,000	*
H. & H. Ref. Co., Osawatomie	1,000	*
Imperial Ref. Co., Cherryvale	2,400	*
Kanotex Ref. Co., Arkansas City	3,000	2,400
Kansas Oil Ref. Co., Coffeyville	2,000	550
Kansas City Ref. Co., Kansas City	5,000	3,150
Kansas-Texas O. Ref. Co., Wichita	1,500	*
Lesh Ref. Co., Arkansas City	1,500	800
Lakeside Ref. Co., Augusta	2,000	850
Midland Ref. Co., El Dorado	6,000	5,550
Marshall & Co., Sheffield	2,500	*
Mutual Ref. Co., Chanute	1,500	500
Moore Ref. Co., Arkansas City	4,500	3,800
McCree Pet. Co., Baxter Springs	600	*
Mo-Kan Ref. Co., Kansas City	1,000	*
McWhorter-Chanute Ref. Co., Chanute	200	*
Miller Pet. Co., Humboldt	1,500	700
National Ref. Co., Coffeyville	5,000	4,700
North Amer. Ref. Co., Rosedale	700	*
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Richardson Ref. Co., El Dorado	2,000	*
Sinclair Ref. Co., Coffeyville	7,000	4,600
Red Bird Ref. Co., Fredonia	800	*
Sinclair Ref. Co., Argentine	6,000	6,000
Sterling Oil & Ref. Co., Wichita	5,000	3,900
St. Louis Oil & Ref. Co., El Dorado	1,500	*
Stand. O. Co. (Kan.), Neodesha	12,000	8,600
Vickers Pet. Co., Potwin	1,800	550
White Eagle Ref. Co., Augusta	6,000	6,000
Wilholt Ref. Co., Joplin	2,000	850

OKLAHOMA

Company and Location—	Daily Capacity	Now Running
Acme Ref. & P. L. Co., Jennings	2,500	*
Allied Ref. Co., Okmulgee	2,000	900
Associated P. & R. Co., Yale	1,000	*
Barnsdall Ref. Co., Barnsdall	3,000	2,600
Bay State Ref. Co., Healdton	1,000	*
Beaver P. & R. Co., Dilworth	700	*
Big Six Ref. Co., Sapulpa	800	*
Bison Ref. Co., Quay	1,000	*
Bolene Ref. Co., Enid	3,600	2,000
Buffalo Ref. Co., Yale	1,000	*
Burk-Cushing Ref. Co., Cushing	1,000	*
Cameron Ref. Co., Ardmore	3,500	2,100
Canfield Ref. Co., Yale	500	100
Carter Oil Co., Cartoco	12,000	*
Champlin Ref. Co., Enid	15,000	5,000
Cherokee Ref. Co., Oilton	1,000	*
Chestnut & Smith Corp., Sand Springs	5,000	*
Choa: Oil Corp (now owned by Chas. F. Noble), Oklahoma City	2,200	*
Coleman Nelson Corp., W. Tulsa	2,000	*
Coleman Nelson Corp., Haskell	1,000	*
Constantine Ref. Co., W. Tulsa	4,500	*
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Cushing Ref. & Gasoline Co., Cushing	1,500	1,500
Cyril Ref. Co. (Apex Pet. Co.) Cyril	1,200	650
Daisy Bell Pet. Co., Wilson	2,000	250
Damascus Ref. Co., Lawton	1,500	*
Donnelley Oil Works, Blackwell	1,000	1,000
El Dorado Ref. Co., Yale	700	*
Equality Ref. Co., Oilton	1,000	*
Empire Refineries, Inc., Cushing	5,000	3,300
Empire Refineries, Inc., Okmulgee	2,500	2,100
Emp. Refineries, Inc., Okla. City	2,500	*
Emp. Refineries, Inc., Ponca City	4,500	3,400
Frances Ref. Co., Frances	500	*
Frederick Ref. Co., Frederick	500	*
Fairmont Ref. Co., Fairmont	2,500	800
Federal O. & Ref. Co., Cushing	1,500	*
Globe Oil & Ref. Co., Blackwell	4,000	3,800
Gilmer Oil Co., Ringling	800	200
Golden Belt Ref. Co., Okla. City	200	*
Grandfield O. & R. Co., Grandfield	3,000	600
Great Amer. Ref. Co., Jennings	2,500	*
Hewitt Ref. Co., Hewitt	1,600	*
Home Oil & Ref. Co., Yale	2,000	*
Indian Oil & Ref. Co., Cushing	1,800	*
Illinois Oil Co., Cushing	3,000	750
Illinois Ref. Co., Bristow	2,500	*
Imperial Ref. Co., Ardmore	5,000	4,100
Indiahoma Ref. Co., Okmulgee	9,000	3,100
Inland Ref. Co., Cushing	1,800	*
Johnson Oil Ref. Co., Cleveland	2,500	1,500
Lawton Ref. Co., Lawton	1,000	*
Livingston Ref. Co., Walters	3,000	*
Local Ref. Co., Oklahoma City	1,000	700
Marland Ref. Co., Covington	1,000	500
Marland Ref. Co., Ponca City	12,000	12,000
Mecca Ref. Co., Allen	1,500	*
Meridian Pet. Corp., Okmulgee	3,000	*
Meridian Pet Corp., Hominey	1,000	*
Meridian Pet. Corp., Ponca City	2,500	*
Mid-Co Pet. Co., West Tulsa	7,000	*
North Amer. Ref. Co., Pemeta	1,500	*
Nyanza Ref. Co., Wilson	3,500	600
Oil State Ref. Co., Enid	2,500	750
Pontotoc P. L. & Ref. Co., Allen	600	250
Omar Ref. Co., Garber	2,500	1,100
Oklahoma P. & R. Co., Muskogee	2,500	1,750
Pawhuska Ref. Co., Pawhuska	1,000	100
Waite Phillips Co., Okmulgee	3,000	2,100
Pierce Oil Corp., Sand Springs	9,000	7,400
Polar Prod. & Gas. Co., Sapulpa	2,000	*
Producers & Refiners Corp., West Tulsa	6,000	3,800
Producers & Refiners Corp., Blackwell	2,500	2,300
Pure Oil Co., Ardmore	7,000	3,400
Pauline Ref. Co., Hampton	1,200	500
Pure Oil Co., Cushing	6,500	2,750
Powerine Oil Co., Billings	500	*
Pioneer Pet. Co., Guthrie	2,500	*
Pirtle-Pittman Ref. Co., Newkirk	2,000	200
Rock Island Ref. & P. L. Co., Duncan	1,200	1,000
Santa Fe Oil & Ref. Co., Ardmore	5,000	*
Sapulpa Oil & Ref. Co., Sapulpa	7,000	4,500
Shaffer Oil & Ref. Co., Cushing	6,500	4,000
Southern Oil Corp., Yale	6,000	*
Southern Oil Corp., Walters	2,500	*
Southwestern Oil Corp., Enid	1,800	*
Sun Company, Yale	4,000	2,100
Sinclair Ref. Co., Cushing	5,500	4,400
Sinclair Ref. Co., Muskogee	2,000	1,200
Texas-Okla Ref. Co., Grandfield	1,500	1,100
Texas Company, West Tulsa	8,000	7,600
Tidal Ref. Co., Dumright	4,500	3,800
Transcontinental Oil Co., Boynton	3,000	2,100
Transcontinental Oil Co., Bristow	5,000	4,800
Travis Center Ref. Co., Beckett	1,500	650
Union Oil & Ref. Co., Grandfield	2,500	*
Turley Ref. Co., Oklahoma City	2,500	*
Wagoner Ref. Co., Wagoner	500	*
Wilcox Ref. Co., Bristow	300	300
Yale Oil Corp., Yale	1,200	550

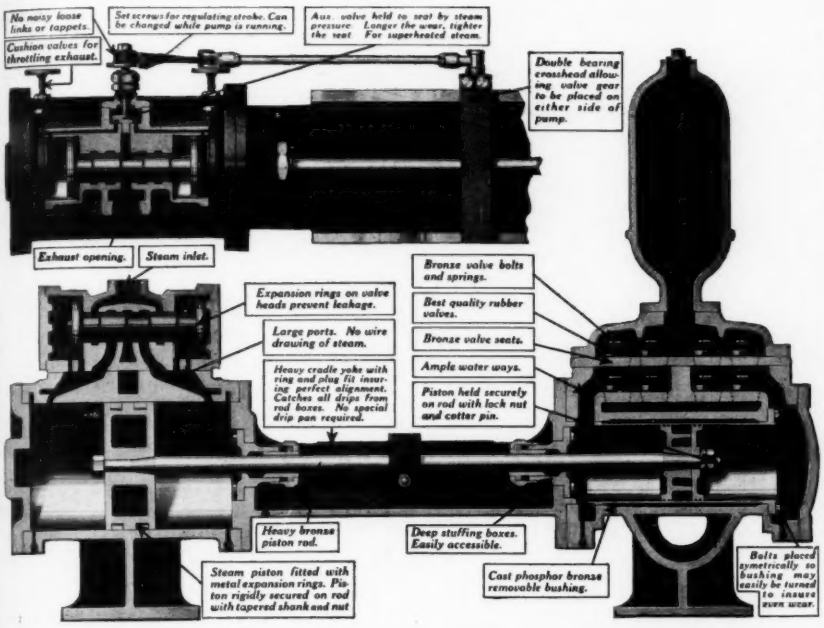
NORTH TEXAS

Company and Location—	Daily Capacity	Now Running
American Oil Corp., Pioneer	2,500	1,000
American Ref. Co., Wichita Falls	5,000	3,800
H. E. Boner, Burkburnett	700	*
The Petroleum Corp., Electra	2,000	550
Buffalo Ref. Co., Sherman	500	150
Burk-Texas Ref. Co., Burkburnett	1,200	*
Bear Ref. Co., Burkburnett	1,200	*
Clayton O. & Ref. Co., Dallas	3,500	*
Crystal Pet. Co., Burkburnett	1,000	200
Eastland-Pioneer Oil & Ref. Co., Cisco	1,000	*
Empire Refineries, Inc., Gainesville	7,000	3,900
General Refining Co., Abilene	1,500	*
Gulf Ref. Co., Fort Worth	15,000	6,000
Gorman Home Ref. Co., Gorman	1,000	*
Griswold Oil Co., Electra	2,000	1,600
Humble Oil & Ref. Co., Burkburnett	1,500	1,150
Invincible Oil Corp., Fort Worth	5,000	*
Interstate Gasoline Product Co., Iowa Park	2,000	750
Iowa Park Prod. & Ref. Co., Iowa Park	1,000	600
Keystone Ranger Ref. Co., Wichita Falls	2,000	*
Lone Star Ref. Co., Wichita Falls	4,000	650
Manhattan Ref. Co., Burkburnett	3,000	....
Manhattan Pet. Prod. Co., Wichital Falls	2,500	*
Miller Pet. Co., Wichita Falls	2,500	1,600
Magnolia Pet. Co., Fort Worth	12,500	6,250
Noble Oil & Gas Co., Burkburnett	5,000	900
Nortex Ref. Co., Burkburnett	2,000	850
North Texas Ref. Co., Greenville	1,000	*
Owenwood Oil Corp., Burkburnett	2,000	*
Oriental Ref. Co., Dallas	5,000	500
Odessa Ref. Co., Ranger	1,000	*
Orient Pet. Co., Wichita Falls	2,000	500
Pierce Oil Corp., Fort Worth	10,000	*
Panhandle Ref. Co., Wichita Falls	4,500	3,100
Panther City Ref. Co., Ft. Worth	2,000	*
Primrose Ref. Co., Wichita Falls	1,500	500
Ranger Wichita Ref. Co., Wichita Falls	5,000	*
Ranger P. L. & Ref. Co., Ranger	2,500	*
Ranger P. L. & Ref. Co., Tiffin	2,000	*
Star Ref. Co., Fort Worth	1,500	450
State Ref. Co., Dallas	1,000	250
Sunshine State Ref. Co., Wichita Falls	2,500	1,000
Tidal Western Ref. Co., Burkburnett	3,000	1,700
Texas Company, Dallas	15,000	7,500
Texhoma Oil & Ref. Co., Wichita Falls	4,500	1,200
Transcontinental Oil Co., Fort Worth	5,000	3,100
Travis Ref. Co., Burkburnett	1,000	250
Great Texas Ref. Co., Deleon	700	*
Uniform Pet. Co., Burkburnett	4,000	*
Victor Ref. Co., Burkburnett	2,000	*
Wagoner Ref. Co., Electra	3,400	750
Walker Consolidated Ref. Co., Iowa Park	2,500	*
White Eagle Ref. Co., Fort Worth	5,000	450
Waco Ref. Co., Waco	500	*

LOUISIANA

Company and Location—	Daily Capacity	Now Running
Caddo Central Oil & Ref. Co., Shreveport	3,500	*
Caddo Central Oil & Ref. Co., Shreveport	7,000	4,500
Crescent Oil & Ref. Co., Cedar Grove	600	*
General Oil & Ref. Co., Oil City	2,000	*
Great Southern P. & Ref. Co., Ardis	2,000	*
Homer Ref. Co., Homer	250	*
International Oil & Ref. Co., Shreveport	800	*
Leeston Ref. Co., Shreveport	800	*
Louisiana Oil Ref. Co., Shreveport	9,000	5,100
Louisiana Pet. Products Co., Bossier	300	*
Paramount Pet. Co., Superior	3,000	*
Paramount Ref. Co., Vivian	3,000	*
Red River Ref. Co., Crichton	1,800	1,500
Rogers Ref. Co., Shreveport	700	*
Shreveport P. & R. Co., Shreveport	4,500	4,100
Sunset Ref. Co., Plaquemine	600	400
Texas Company, Ardis	5,000	25,000

American-Marsh Refinery Pumps


No noisy loose links or tappets.
Set screws for regulating stroke. Can be changed while pump is running.
Aux. valve held to seat by steam pressure. Longer the wear, tighter the seat. For superheated steam.
Cushion valves for throttling exhaust.
Double bearing crosshead allowing valve gear to be placed on either side of pump.
Exhaust opening.
Steam inlet.
Bronze valve bolts and springs.
Expansion rings on valve heads prevent leakage.
Best quality rubber valves.
Large ports. No wire drawing of steam.
Bronze valve seats.
Heavy cradle yoke with ring and plug fit insuring perfect alignment. Catches all drips from rod boxes. No special drip pan required.
Ample water ways.
Piston held securely on rod with lock nut and cotter pin.
Heavy bronze piston rod.
Deep stuffing boxes. Easily accessible.
Steam piston fitted with metal expansion rings. Piston rigidly secured on rod with tapered shank and nut
Cast phosphor bronze removable bushing.
Bolts placed symetrically so bushing may easily be turned to insure even wear.

The illustration tells its own story. Why the American-Marsh is the logical pump for use in your refinery.

Note the extra wide passages and large valve area which make them especially adapted for handling oil and other refinery products.

The line includes:
Centrifugal Pumps
Acid Pumps
Oil Pumps
Dry Vacuum Pumps
Air Compressors
Jet Condensers
Hydraulic Pressure Pumps

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Company and Location—	Daily Capacity	Now Running
Union Ref. & P. L. Co., Oil City	1,000	*
Union Ref. & P. L. Co., Homer	1,000	*
ARKANSAS		
Abner Davis, El Dorado.....	60	*
Airedale Ref. Co., El Dorado....	1,000	*
Arkansas Oil Ref. Co., Fort Smith	1,000	*
Arkansas Prod. & Ref. Co., El Dorado	1,000	1,000
El Dorado Prod. & Ref. Co., El Dorado	1,500	*
Grison Ref. Co., El Dorado	750	*
Jones Bros. & Tatum, El Dorado	1,000	550
Kettle Creek Ref. Co., Pearson ..	2,000	1,500
Lions Oil & Ref. Co., El Dorado	5,000	3,500
MacMillian et al, El Dorado....	1,500	350
Pine Bluff Ref. Co., Pine Bluff..	1,000	900
Root Refineries, El Dorado.....	3,000	1,400
Shippers Pet. Co., El Dorado...	1,800	550
Union P. L. & Ref. Co., El Dorado	4,000	800
The Arkansas Ref. Co., Picoro....	3,000	*

*Shutdown. †Running reduced crude. ‡Topping.

Will Install Dubbs Units At Industrial Refinery

El Dorado, Kans.—An extensive betterment program, involving an expenditure of around $100,000 is planned for the Industrial Refining Company, recent purchaser of the Trapshooter's refinery here from the St. Louis Oil and Refining Company. The new owners contemplate the installation of several Dubbs cracking units.

C. H. Montgomery of Wichita, formerly with the Midland Refining Company and later with the Sterling Oil and Refining, is superintendent of the new company and H. R. Keplinger, formerly with the St. Louis Oil and Refining, is in charge of office administration.

Association of Natural Gasoline Mfgrs. Elects Burk and Chase Vice Presidents

Tulsa, Okla.—W. E. Burk of Okmulgee, Okla., secretary of the Highway Oil Refining Company, and F. L. Chase of Dallas, Texas, operating manager of the Lone Star Gas Company, have been elected active vice presidents of the Association of Natural Gasoline Manufacturers. C. C. Herndon, vice president of Skelly Oil Company, who was elected vice president of the Association at the annual meeting held here in April has advised that he is unable to serve.

The Association has retained the services of George A. Prevost of Washington, patent attorney, to investigate the merits of all patents affecting the welfare of the natural gasoline industry.

A committee has been named to look into the matter of winter storage. This committee is composed of W. H. Gray, chairman; F. E. Rice, George R. Fisher, J. W. Hurley, S. C. Carney and H. W. Harts. A sales managers committee also has been appointed, consisting of A. F. Garrett, R. R. Rosier, A. F. Wood, L. H. Deatherage, A. M. Ballard, B. E. Blankenship, O. W. Crick and H. A. Trower.

The following companies were represented at the meeting of the Association:

Chestnut & Smith Corp., Tidal Refining Co., Roxana Petroleum Corp., Akin Gasoline Co., Amity Gasoline Co., Liquefied Petroleum Gas Co., Pulaski Oil Co., Transcontinental Oil Co., Midco Gasoline Co., Wooster Gasoline Co., Hesco Gasoline Co., Arkansas Natural Gas Co., McMann Oil Co., Highway Oil Refining Corp., Oil State Gasoline Co., Hudley Gasoline Co., Diamond Refining Co., Wilcox Gasoline Co., Stebbins Oil & Gasoline Co., Natural Gas & Petroleum Corp., Marland Refining Co., Chieftain Gasoline Co., Sand Springs Gasoline Co., Cosden & Co., Tribes Gasoline Co., Oklahoma Eastern Oil Co., World Gasoline Co., Amerada Petroleum Corp., Skelly Oil Co., Orfic Gasoline Co., Livingston Petroleum Corp., Twin State Oil Co., Oklahoma Gasoline Plants, Inc., Southland Gasoline Co., Finco Gasoline Co., Western Oil Corp., Sinclair Oil & Gasoline Co., D. E. Foster, Benwick Gasoline Co., Southern Carbon Co., Rotary Gasoline Co., Blue Ribbon Gasoline Co., Victor Gasoline Co., Henaghan & Hanlon, Hope Engineering & Supply Co.

New York, N. Y.—More than $1,000,000 will be required to handle a deal which, it is understood here, Texas Pacific Coal & Oil Company is negotiating. The deal includes the acquisition of a modern refinery, with cracking stills and a lubricating plant. It is said the company plans to issue new stock at par to pay for the new properties.

CHESTNUT & SMITH CORPORATION

Natural Gasoline Blends
All Grades

General Offices

Chestnut & Smith Corporation Building, Tulsa, Oklahoma

REFINERY AND GASOLINE PLANT ACTIVITIES

High Water Results in Much Damage to Oklahoma Plants

Kansas City, Mo.—Means of rehabilitating refineries in Oklahoma and Kansas that were put out of commission by the high water in June came up for discussion at a meeting of the Western Petroleum Refiners Association held here June 12 at the Hotel Muehlebach. George N. Moore, president of the association, presided and refiners were in attendance from virtually all sections of the Mid-Continent and other districts.

Much damage was done the plant of the Moore Refining Company at Arkansas City, Kansas, and also to the Lesh plant there which reported a 55,000 barrel tank almost full of gasoline being washed from its foundation. Damage to the Moore plant will reach many thousands of dollars while construction work on the new refinery at Arkansas City of the Roxana Petroleum Company was halted by the flood waters. It is understood here that this company will spend in excess of what had been figured on so that the danger from high water will not occur again as far as their property is concerned.

All along the Arkansas river high water played havoc with refining plants. At Tulsa Cosden and Company kept the water back by means of embankments and this method of protection was used at other points along the river. Considerable damage to the refineries was reported from Wichita, Kansas.

New Refinery Will Be Put Up on Site Near Camden

Camden, Ark., June 20.—Work is to be commenced shortly on the construction of a refinery, costing approximately $300,000, in the outskirts of this city. The plant is being built by the Morris interests, who recently purchased a tract of land west of the city limits. The local chamber of commerce donated 20 acres adjacent to that bought, as a bonus for locating the refinery here.

Seventh Floor Vaporizing

He: "I passed your house last night."

She: "Thanks."

Baltic to Erect Large Gasoline Plant in Texas

Fort Worth, Texas.—A 6,000,000 cubic foot daily capacity absorption gasoline manufacturing plant is being erected by the Baltic Gasoline Company, Inc., in Stephens County, Texas, at an estimated cost of $150,000. The plant is located on the Peter Swenson lease, Section 5, Orphan Asylum land, and will be in four units. The gas in this section is reported to average a yield of 1½ gallons of natural gasoline per 1000 cubic feet. The entire equipment for the plant has been contracted for with the National Supply Company.

The Baltic Gasoline Company, Inc., maintains headquarters at 418-20 Guaranty Bank Bldg., Ranger, Texas, and the officers are: E. D. Finney of Ranger, president; R. W. Thomas of Ranger, vice president and general manager; T. H. Fitchett of Baltimore, Md., secretary-treasurer; and F. H. Steed, plant superintendent.

A. B. Leach and Company Get Massachusetts Refinery

Boston, Mass.—Sale of the properties of the Massachusetts Oil Refining Company to A. B. Leach and Company for $2,500,000 has been confirmed by the superior court and deed to the properties has been tendered on court order.

In the event payment was not made within sixty days title to the properties will be once more vested in the court.

Buffalo, N. Y.—The N. B. Fails Lubricating Company of Buffalo has been acquired by the Swan and Finch Company and the business of the company will be continued under the name of the Fails Oil Company, a $20,000 corporation. The company compounds greases, mineral soaps and blended products and also operates a string of service stations in Buffalo, which are included in the deal with Swan and Finch.

Wichita, Kansas.—Re-financing of Derby Oil Company of Wichita through incorporation as the Derby Oil and Refining Company of Delaware has been completed and the company has a capitalization of around $15,000,000. The company's refining capacity is to be doubled and other improvements made.

Anglo-Scottish Finance Backing Dr. Hermann Wolff

London, Eng.—(By mail)—The Anglo-Scottish Corporation, an English concern that has bought the British government's refinery at Chester for conducting experimental work on the "Mutol" process of obtaining gasoline from crude oil, is backing Dr. Hermann Wolff, chief chemist of the Badische Anilin Works and inventor of the process.

It is said that Dr. Wolff confidently believes that his process in time will drive out the cracking processes now in use through immense savings, as he claims his 5-ton to 10-ton units can be managed by one man. He also claims that by his process the percentage of fine benzine extracted from crude oil is 65 per cent or even 75 per cent as compared with a much lower yield by cracking.

Clayton Plant Installing New Type Cross Towers

Dallas, Texas.—The Clayton Oil & Refining Company, which has 5,000 barrels daily capacity skimming plant located near this city and now adding two units of the Cross cracking process, has announced that the tew type of towers recently perfected by Dr. Walter Cross is being installed at an expense of about $5000. Two of the Cross towers were recently given a trial at the Clayton plant, and as result of their performance the balance of the stills are to be equipped with the same type. The recovery from the Cross towers is reported to be almost the same as that of the towers that have been in use at the plant, and the change will net a big saving to the company over the year in royalties.

Another Gasoline Plant To Operate at Sallyards

Eureka, Kans.—Plans have been made by Sinclair Oil and Gas Company for the erection of a casinghead gasoline plant on the Butler-Greenwood county line in this state in section 16-26-8 to cost in excess of $200,000.

The plant will operate on gas from the Sallyards pool and will be the second plant in the district, the Empire having recently completed a plant in the Teter area.

A view of the extensive improvements being made by the Lion Oil and Refining Company of Kansas City on its El Dorado, Arkansas, plant, which is being doubled in capacity. Batteries of Burton stills are shown to the left, while the company's original plant occupies the right end of the picture

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CONFIDENCE — Placed in this organization by purchasers—that we are capable and equipped to supply their requirements for producing and refining equipment, is, in a large measure, the reason for the ever increasing volume of business placed with us.

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Quotations will be promptly made without cost or obligation to you.

United Iron Works, Inc.,
Kansas City, Missouri.
Tulsa, Okla. Dallas, Texas.

P. & R. Approves Plans To Enlarge Parco Plant

Casper, Wyo.—It is learned here that Producers and Refiners Corporation have approved plans for the further enlargement of their plant at Parco, Wyo., on the Union Pacific. The company's skimming plant has been in operation since last April and construction work on the lubricating and wax plants is nearing completion. The plant is running on crude from the Ferris and Lost Soldier fields but it is expected that before the summer is over crude from the Salt Creek field will be used as the P. & R. line from that area is being rushed.

Natural gasoline plants of P. & R. as well as the company's pipe line systems are being extended to handle available gas production on the company's properties, including the recent acquisition at Amarillo, Texas. Gas distributing lines have been built in several cities where the company has franchises.

Lone Star to Build Largest Gasoline Plant for Texas

Dallas, Texas.—Construction work on the largest capacity natural gasoline plant in Texas is to be started shortly by the Lone Star Gas Company of this city near the town of Gordon, Palo Pinto County, and plans are to have it in operation before September 1. The plant will use combination absorption and compression process, and will have a daily charging capacity of 60,000,000 cubic feet. It is planned to install 16 absorbers and two compressors.

A site for the plant has been purchased on the Conway farm in the Thomas Reed survey, about two miles east of Gordon, and gas will be furnished by the company's 18-inch gas main which is being laid from Eastland, Ranger and Desdemona fields in Eastland County and Strawn field in Palo Pinto County to Dallas and Fort Worth at an estimated cost of $5000,000, including the cost of the plant. The 18-inch line is now completed from Dallas to Judd in Palo Pinto County, and the balance of the project will be ready for operation, according to present plans by September 1.

The Lone Star Gas Company supplies domestic and industrial gas for hundreds of cities and small towns in North and Central Texas and has contracted for the residue gas from a number of natural gasoline plants in Eastland, Ranger, Desdemona and Strawn fields, in addition to direct connections with gas wells in these fields. This gas will be turned into the 18-inch line and run through the plant at Gordon before reaching the consumer. No estimates have been given on the expected gasoline yield from the new plant which is not only to be the largest, but one of the most efficient plants in the state.

Kansas City, Mo.—An order for 2,500,000 gallons of 64 gravity gasoline has been received by the White Eagle Oil and Refining Company here from its newly opened office in Paris. The order is to be shipped from the company's export station near New Orleans.

New Sinclair Refinery Is Almost Completed

New York, N. Y.—The new refinery of Sinclair at Marcus Hook, Pa., is nearing completion and will be ready for operation early in the autumn. This plant will have the very latest equipment for extracting the largest percentage of gasoline from crude oil.

With extensive improvements under way at Sinclair refineries at East Chicago, Kansas City, Coffeyville, Cushing and Houston, the company will be able to make about three gallons of gasoline where a year ago it made one.

For providing funds to reimburse the company for expenditures on the Marcus Hook, Pa., refinery and on plants in other sections of the country, Sinclair Consolidated Oil Corporation has sold $25,000,000 first lien collateral fifteen year 6½ per cent gold bonds through Blair and Company.

Laredo Refinery Expects To Begin on September 1

Laredo, Texas.—Construction work on the 1,500 barrels daily capacity refinery being erected by the Misko Refineries, Inc., on the Texas-Mexican railway near Mirando City, Texas, is well underway, and present plans are to begin operation about September 1. This plant represents an investment of approximately $200,000 and will manufacture Diesel motor fuel and pale lubricating oils from crude obtained from the Mirando City field through the Associated Pipe Line Company's line. It is reported that a cracking unit is being contemplated for use in connection with the refinery.

Headquarters of the Misko Refineries, Inc., are located at Laredo, P. O. Box No. 399, and the officers follow: O. W. Killam, president; W. T. Killam, treasurer, and S. P. Coblentz, formerly with Humble Oil & Refining Company, secretary and general manager.

Modern Refinery Bought By Cushing Gasoline Co.

Cushing, Okla., May 28.—The refining plant of the Modern Refining Company at Blackwell, Oklahoma, has been bought by the Cushing Refining & Gasoline Company. The buyer has taken over the Blackwell plant and will operate it. This gives the concern daily refining capacity of 3,000 barrels in its two plants.

Officials of the company are E. C. Mullendore of Coeveland, Okla., president; E. J. Blank of Cushing, vice president; R. C. Jones of Cushing, secretary-treasurer; Thomas N. Berry of Stillwater, a director, and Rex H. Winget, general manager.

The first four of these officials own the Mul-Berry Oil Co. With the Cushing Refining & Gasoline company they also control the Blackwell Oil & Gas Co., which has 7,000 barrels daily production in the Tonkawa field.

Thermopolis, Wyoming.—It is planned to reorganize the Alliance Oil & Refining Co., as the Antler Producing and Refining Company here. It is understood the refinery of the company is to be enlarged and a cracking unit installed.

Standard of New Jersey May Buy Grease Plant

Chicago, Ill.—It is learned here that the outlook for the closing of a deal whereby Standard Oil Company (New Jersey) will obtain an interest in the grease business of the Bassisk-Alemite Company of Chicago is favorable. The Bassick company has made an offer which has been virtually accepted by the New Jersey corporation, it is understood.

Several conferences have been held between officials of Bassick-Alemite and Standard of New Jersey participated in by E. W. Bassick and Walter C. Teagle and A. C. Bedford. It is understood that the New Jersey officials have accepted the proposal to place Bassick lubricating pumps in all service stations of the New Jersey corporation on condition that an interest in Bassick be sold to Standard Oil.

Dutch Shell Officials Make Tour of Mid-Continent Pools

Arkansas City, Kans.—A party of high officials of the Roxana Petroleum and Royal Dutch-Shell companies are completing a tour of the company's properties in the Mid-Continent field and stopped off here to inspect the construction of their refinery which will cost around $4,000,000. From here the party went to Ponca City, Oklahoma, and were detained there for several days on account of the high water in that section of Oklahoma.

In the party were J. B. A. Kessler of London, managing director of the Royal Dutch-Shell; F. Godber of St. Louis, president of the Roxana Petroleum; H. Van Dorser of St. Louis and J. W. Bates of Tulsa.

Thomas Becomes Head of Baltic Gasoline Company

Ranger, Texas.—A farewell dinner party was given here recently to R. W. Thomas, assistant superintendent in charge of the Chestnut & Smith Corporation's natural gasoline plants in the Ranger district, when he resigned to become vice president and general manager of the Baltic Gasoline Company, Inc., which is erecting a new plant in Stephens County. The dinner was attended by 50 friends and fellow employes in the Chestnut & Smith Corporation, with Frank B. Crane as toastmaster. F. G. Yonkers, superintendent in charge of the Texas and Oklahoma division was one of the speakers for the occasion.

Climax Oil Company Is Result of K. C. Merger

Kansas City, Mo.—The Climax Oil Company has been formed through the merger of the interests of Albert J. Jones, E. M. Goebel and J. P. Howe, oil operators. Mr. Jones and Mr. Goebel own crude production and also control the Kansas City Refining Co., the Kansas City Refining Sales Company, and the Central States Oil Co., while Mr. Howe and associates own the Manhattan Oil Corporation of Nebraska and Iowa.

Mr. Jones will be in charge of production on the new corporation and chairman of the board. Mr. Goebel will be president and be in charge of refineries, and Mr. Howe will be vice-president in charge of marketing.

Captain Constantin Organizes Tonkawa Petroleum Co.; 2500 Bbl.

Tulsa, Okla.—Captain E. Constantin, former head of the Constantin Refining Co., of this city, has organized the Tonkawa Petroleum Company, which is completing a skimming plant on the Irby farm, southeast of Tonkawa. According to officials of the company the plant will have a capacity of 2500 barrels a day.

S. O. of Indiana Officials Make Visit to the Public

Chicago, Ill.—What may be described as a unique and altogether novel "get together" jaunt has been completed by a party of officials of the Standard Oil Company (Indiana), who started out March 18 on a tour of its marketing area and traveled some 6,000 miles in all, and included visits to the company's properties in Illinois, Indiana, Wisconsin, Missouri, Kansas, Michigan, North and South Dakota, Minnesota and Iowa. Col. Robt. W. Stewart, chairman of the board, headed the party.

Tulsa, Okla.—Pat Malloy, former president and now co-receiver with W. O. Dickenson of Tulsa of the Constantin Refining Company, announces that the receivers have completed negotiations for the leasing of approximately 450 tank cars of Constantin to a large independent refining interest.

OIL REFINERY EQUIPMENT

Crude and Steam Stills
Condenser Boxes
Agitators
Tanks
Towers
Walkways and Stairs

Large Stocks of Materials Prevent Delays
Efficient Shop Service

MASHER

STEEL AND MACHINERY COMPANY
DALLAS, TEXAS

Established 1867

The Vilter Manufacturing Co.

1152-1162 CLINTON ST., MILWAUKEE, WIS.

Vilter High Speed Horizontal Refrigerating Machine

Builders of Refrigerating Machinery, Oil Cooling Coils, Gasoline Condensers, Etc.

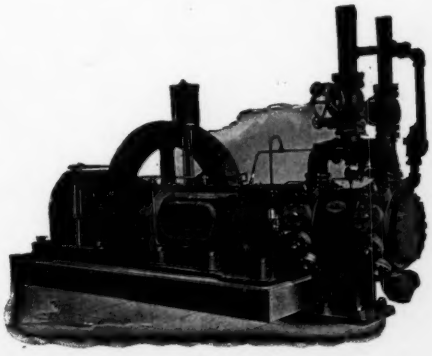
Vilter Equipment is used in many of the oil refineries.

Vilter-Milwaukee typifies the true standard of reliability in machinery construction and refrigerating engineering.

Vilter Low Temperature Compression System (for efficiently producing low temperatures with compression system.)

Vilter Sales Engineers always at your service.

Branch offices in all the principal cities.



÷ REFINERY SUPPLIES ÷

OIL JOBBERS SUPPLIES

Prices based on original packages in large quantities f. o. b. manufacturing point—unless otherwise specified.

Animal, Fish and Vegetable Oils

Lard Oils—	Price June 15
Prime, bbls., lb.	14¼
Extra Winter Strained, bbls., lb.	12¾
Extra, bbls., lb.	12½
Extra No 1, bbls., lb.	12
No. 1, bbls., lb.	11½
No. 2, bbls., lb.	11
Tallow, prime edible, lb.	8½
Tallow Oil, acidless, bbls, lb.	11½
Lard Stearine, bbls., lb.	13½
Oleo Stearine, bbls., lb.	9

Neatsfoot Oil—

Pure 20 cold test, bbls., lb.	17
Pure 30, cold test, bbls., lb.	15
Extra, bbls., lb.	12
No. 1, bbls., lb.	11½
Horse Oil, bbls., lb.	9½
Red Oil, distilled, bbls., lb.	10½
English Degras, bbls., lb.	4¼ 4¼
Domestic Degras, bbls lb.	4¼ 4½

Menhaden Fish Oil—

Light Pressed, bbls., gal.	.80	.87
Yellow bleached, bbls., gal.	.83	.89
Herring Oil, tanks, coast, gal.		.45
Whale Oil, bleached, bbls., gal.	.78	.81
Sperm Oil, bleached, bbls., gal.	.89	.94
Soya Bean Oil, pressed, bbls., lb	12¾	13
Soya Bean Fatty Acids, tanks, West lb.		13
Tallow Fatty Acids, bbls., lb.	.07	.07½

Castor Oil—

No. 1, bbls., lb.	14½
No. 3, bbls., lb.	14

Corn Oil—

Middle West, tanks, lb.	9½	10
Cooperage, l. c. l.		12¼

Linseed Oil—

Carloads, bbls., gal.	$1.12
Less than 5 bbls., gal.	1.18

NAVAL STORES

(Quotations by National Rosin Oil & Size Company, Chicago.)

Rosins—		
B. to I. bbls. (280 lbs.)	$5.80	$6.00
10-20 bbl. lots, f. o. b. shipping point		7.10
K. to WW bbls., (280 lbs.)	6.00	7.50
10-20 bbl. lots, f. o. b. shipping point	6.90	9.00
Turpentine spirits ex yard gal.		$1.05
In drums		1.03
Rosin Oil, first run, gal.		.46
Rosin Oil, second run, gal.		.48
Rosin Pitch, bbl.		6.00
Tar, kiln burned		13.50
Tar, retort		12.50

REFINERS' SUPPLIES

Prices are based on original packages, in large quantities, and represent spot quotations, unless otherwise stated, f. o. b. manufacturing points.

(Quotations by Wishnick-Trumpeer Chem. Co., Chicago.)

Soda Ash, light bags, cwt.	1.75	2.10
Silicate of Soda, 60 deg., tanks cwt.	1.60	
Sal Soda, cwt.	1.15	1.25
Caustic Soda 76% drums cwt.	3.26	3.75
Chlorate of Soda, kegs, lb.	6½	7
Nitrate of Soda, cwt.	2.45	
Potash Permanganate	.18	.19
Potash Bichromate sacks, lb.	11¼	12
Sulphuric Acid, 66 deg., tank cars ton	15	16
Acetic Acid—		
28% bbls., cwt.	3.38	3.63
56% bbls., cwt.	6.78	7.13
80% bbls., cwt.	11.41	11.60
Fullers Earth, 16-30 mesh, carloads, ton	$23.00	25.00
Chloride of Lime, cwt.	2.00	2.25
Benzol, pure, water white, gal.	.27	.32
Benzol, 90%, gal.	.25	.30
Toluol, gal.		.35

Litharge

Chicago market, bbl. $10.90

Facilities at Your Service in the Chicago Switching District

If the course of your shipments carries them into or about Chicago, it will be of distinct value for you to know about the facilities maintained in the Chicago switching district by the North American Car Company—

At Blue Island: Loaded car storage with a capacity of 500 cars.

At Clearing: Bulk storage with a capacity of 39,000 barrels—ready to receive liquid petroleum products under the usual North American Oil Terminal Warehouse arrangement.

At Chicago: Fully equipped repair shops, able to handle all types of car repair work.

Shall we give you further information?

Lessors of Tank Cars

NORTH AMERICAN CAR CO.

327 S. La Salle Street, Chicago

Other Car Works:
Coffeyville, Kans. West Tulsa, Okla.

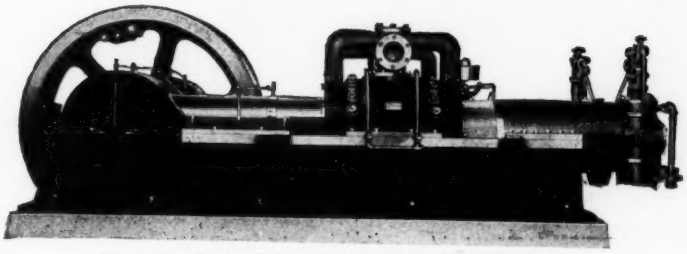
SOUTHWESTERN DISTRICT OFFICE
Petroleum Bldg., Tulsa

THE FROG

What a funny bird the frog is.
When he hops he flies almost.
He ain't got no sense hardly;
He ain't got no tail hardly;
When he stands he sit on what he ain't got hardly.

—Gulf Club Banner.

THE NEW ENCLOSED TYPE



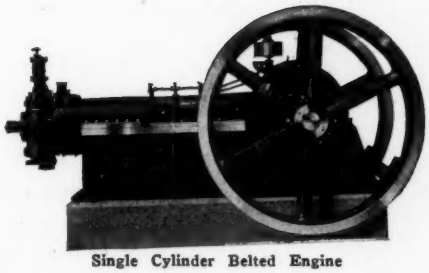
Direct Gas Engine Driven Vacuum Pump, Two Cylinder

Watts-Miller Gas Engines and Direct Gas Engine Driven Compressors and Vacuum Pumps

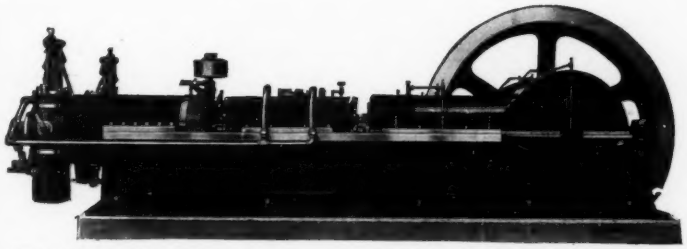
Pat. June 22, 1897; Oct. 6, 1914; April 13, 1915

High Efficiency Gas Engines, Compressors, and Vacuum Pumps for Power Plant Equipment

Sizes from 25 to 400 h. p.



Single Cylinder Belted Engine



Direct Gas Engine Driven Compressor, Two Cylinder, Single or Two Stage

Compressors particularly adapted to casing-head gasoline plants, gas pumping plants, and compressed air installations, in single and 2-stage machines to operate on practically all intake and discharge pressures. Continuous circulating filtering automatic oiling system.

The Miller Improved Gas Engine Co.

SPRINGFIELD, OHIO

DISTRIBUTORS

The Miller Improved Gas Engine Co.
742 Kennedy Bldg.
Tulsa, Okla.

FRICK-REID SUPPLY CO.
Casper,
Wyoming.

Service Department and Warehouse, 323 North Cheyenne St., Tulsa.

Bessemerize Your Equipment and Get

PLUS *Value*

Take

the largest and best equipped plant building oil field engines (less than one-third shown in illustration)

Plus

twenty-five years of concentrated study in perfecting designs and construction

Plus

the practical first-hand experience gained through 26,000 installations of Bessemer engines

Bessemer Oil Field Equipment

- Bessemer Oil Field Engines
- Standard Reverse Clutches.
- Type S-G Clutch, newest improved Bessemer equipment.
- Commercial Gas Engines.
- Roller Pumping Powers.
- Gas or Vacuum Pumps.
- Direct Gas Engine Driven Pumps.
- Direct Gas Engine Driven Compressors.
- Belted Compressors.
- Combination Oil and Gas Engines.
- Oil Engines.
- Complete Gasoline Plants.

Plus

a complete engineering staff organized to give expert and up-to-date counsel on all problems of installation and operation

and you get

full value for every dollar invested plus assurance of complete satisfaction.

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BESSEMER OIL FIELD ENGINES – COMPRESSORS VACUUM PUMPS – ROLLER PUMPING POWERS